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PRIMARY NERVE TUMORS OF THE NECK AND MEDIASTINUM

WITH A REPORT OF THREE CASES

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PRIMARY nerve tumors of the peripheral nervous system are relatively rare with the exception of the type described by von Recklinghausen and the neurogenic sarcomata of Ewing. Because of their comparative rarity it has occurred to us that it would be of interest to offer a report of three cases of tumors in the neck and mediastinum which are related to the sympathetic and spinal ganglia together with a review of the literature pertaining to tumors of this type.

CASE REPORTS

CASE 1. The patient, a man 51 years of age, came to the Clinic on March 9, 1927, because of a tumor mass in his neck, which had been present for 20 years. During the preceding 3 years he had suffered from shortness of breath, a sensation of pressure in the chest, and general weakness. He had no pain or cough. His family history was irrelevant.

Physical examination revealed a well developed, muscular man, 6 feet in height and weighing 195 pounds. The skin was of good texture, the hair was normally distributed, and the eyes were normal with equal pupils which reacted normally. The nose was normal. The teeth were in a poor state of preservation and the tonsils were enlarged. The tongue was clean, and on protrusion it remained in the midline. The neck was large, with a bulging tumorous mass on the right side, about 12 centimeters in diameter, firm and extending below the clavicle (Figs. 1, 2, and 3). The skin overlying this enlargement was not adherent. The chest was symmetrical and the respiratory excursions were good and equal. There was a dull percussion note at the apex of the right lung. The area of retrosternal dullness was 12 centimeters in width. The breath sounds were normal. The apex beat was at the left nipple line. The pulse rate was 78 in both radial arteries. The systolic blood pressure was 130 and the diastolic, 74. There were no abnormal heart sounds. The veins over the lower portion of the abdomen were distended. A healed, appendiceal scar was present. The liver and spleen were not palpated. No tenderness or tumor masses were found. Dilated, tortuous veins were visible in both legs, which, however, showed good muscular tone and strength. The reflexes were normal and there were no disturbances in sensation.

The laboratory findings were as follows: Urinary findings: acid; specific gravity, 1022; no albumin or sugar; microscopically clean. Blood findings: white blood count, 8000; hæmoglobin (Tallqvist), 80 per cent; blood sugar, 3 hours after meals, 126 milligrams per 100 cubic centimeters. The Wassermann and Kahn blood reactions were negative.

Radiographic examination showed moderate hypertrophic osteoarthritis of the dorsal spine. A large, dense shadow was present, extending from the sixth cervical vertebra to below the second rib anteriorly and encroaching upon the apex of the right lung. The trachea deviated to the left (Fig. 4).

The patient was admitted to the hospital on March 9. On March 12 the tumor mass was examined through a low-collar incision and was found to be firm, lobulated and encapsulated, and firmly fixed to the surrounding fascial structures. The right carotid artery was displaced to the left of the midline. A pyramid-shaped nodule was removed for biopsy and the incision was closed. This nodule had a homogeneous, fibrous cut surface. From the microscopical examination the diagnosis of neurofibroma was made. The patient was told that any further operative procedure would be attended with considerable risk and he was discharged on March 24.

On May 5 the patient returned, stating that he had grown weaker and was suffering increasingly from the sensation of pressure in the chest and from dyspnœa. He had recently experienced transient numbness of the right arm. Although the risk incident to the removal of the tumor was again explained to the patient, he insisted that an operation be performed.

At operation, which was performed on May 9, a low-collar incision was made, and the tumor mass on the right side of the neck was found to be an extension from a larger tumor which involved the anterior, superior, and middle mediastinum. The manubrium sterni was resected, and the structures surrounding the tumor mass were divided. The right subclavian artery and vein, which were surrounded by the tumor mass, were also resected (Fig. 5). The point at which the pleura on the right side was opened during removal of the tumor was covered with muscle. The large space left after removal of the tumor was filled with gauze packs. There was partial paralysis of the right forearm and hand following the operation. Though the color of the hand was good, the pulse on the right side could not be felt. On the third day after operation the patient died from mediastinitis and pleuritis.

Pathological report (*Fig. 6*). Gross findings: A nodular, firm mass of tissue weighing 550 grams and measuring 15 by 11 by 8 centimeters. Some of the nodules have a constricted base and thus give the specimen a lobulated appearance. Numerous strands of tissue are attached to the specimen, extending over it in a network-like arrangement. The cut surface is dull white, lusterless and shows striations. The specimen is of uniform consistency throughout.

Microscopical findings: Sections show wavy bundles of collagenic fibrils with flattened, small, narrow nuclei in linear arrangement between the fibrils. In some areas there are small, round, homogeneous acidophilic bodies resembling colloidal deposits (Fig. 7).

Pathological diagnosis: neurofibromata.

Necropsy report (*excerpt*). On removal of the sternum with the attached costal cartilages, the trachea and mediastinal structures were found to be displaced to the left. The superior mediastinum contained a cavity about 15 centimeters in diameter with a shaggy lining covered with small blood clots and a fibrinous exudate. The greater portion of the cavity was on the right side and it extended up into the neck. The right subclavian artery and vein had been ligated and a large segment had been removed. The right pleural cavity was found to contain about 200 cubic centimeters of blood stained fluid. The pleura was dark red and was covered with fibrinous exudate. The right lung was collapsed, flabby, moist, and on section the base was found to be dark red. Blood stained, frothy, serous fluid dripped from the cut surface.

The prevertebral ganglia on the right side, corresponding to first, second, and third thoracic segments, were not identified.

Anatomic diagnosis: acute mediastinitis with acute pleuritis in right pleura; collapse of right lung; acute passive congestion of the right lung and displacement of mediastinum to left.

CASE 2. The patient was a white girl, 8 years of age, who came to the Clinic on September 12, 1927. She had had a brassy cough and audible breathing for the past 3 years. One year previous to the onset of these symptoms she had had scarlet fever, and at 10 months of age she had had whooping cough. At the time of this examination she was having, at intermittent periods, difficulty in breathing, a loss of appetite, headache, and vomiting. X-ray treatment of the chest had been carried out during the preceding 8 months.

Physical examination revealed a well developed, fairly well nourished girl, 4 feet 4 inches in height and weighing 62 pounds. The temperature was normal. The blood pressure was 105 systolic and 55 diastolic. The pupils were equal and reacted normally. There was slight dilatation of the veins at the base of the neck and over the upper chest wall. The respiratory excursion was good. Dullness was noted in the superior mediastinum, which blended with the cardiac dullness and extended beyond the sternum on either side. The breath sounds on both sides were somewhat tubular. The heart and the abdomen were normal. The left shoulder was held higher than the right. No limitation in motion was perceptible. Blood and urine were normal.

An X-ray examination revealed a dense shadow, broader than the sternum, extending anteriorly from above the sternum to below the second rib. The trachea and œsophagus were displaced to the right (Fig. 8).

On the third day after the patient's admission to the hospital, the mass was examined through a low-collar incision and was found to be fixed, ovoid in shape, and to extend from the thyroid gland downward into the chest. It was situated behind the carotid sheath and displaced the trachea to the right (Fig. 9). The mass was smooth, encapsulated, soft, and had a pale grayish surface. A section was removed for microscopical examination and the incision was closed.

Pathological diagnosis: ganglioneuroma (Fig. 10).

CASE 3. The patient, a married woman, 40 years of age, came to the Clinic on August 30, 1927, complaining of a "lump in her neck." This was a palpable and visible, freely movable, firm tumor mass which was situated above the right clavicle and extended downward behind the clavicle toward the midline. It was about the size of a lemon. The patient had noticed the presence of this tumor since the birth of her last child, 4 years before, and during these 4 years it had remained about the same size. Manipulation of the tumor caused pain to radiate down the right arm, and there was an occasional transient pain when the tumor was not moved. The patient was not nervous. She had experienced no palpitation, tremor or weakness, loss of weight, shortness of breath, or choking sensation.

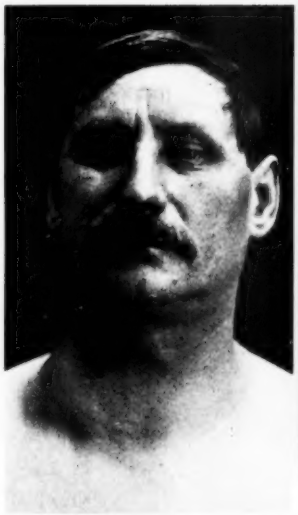


Fig. 1. (Case 1.) Front view of neck showing tumorous mass extending below the clavicle.

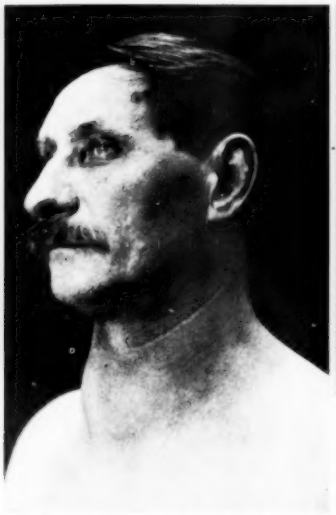


Fig. 2. (Case 1.) Lateral view of neck.

Fig. 3. (Case 1.) Profile view showing tumorous mass at right side of neck.

In childhood the patient had had measles, mumps, chicken pox, whooping cough, and tonsillitis. The only operation that she had undergone was a tonsillectomy in 1925.

Physical examination gave the following findings: Height, 5 feet 4 inches; weight, 170 pounds. Pulse rate, 72. Systolic blood pressure, 100; diastolic, 68. Temperature, 99 degrees F.

The laboratory findings were as follows: Urinary findings: acid; specific gravity, 1005; no albumin or sugar. Blood findings: White blood count, 10,300; hæmoglobin (Tallqvist), 90 per cent; blood sugar 105 milligrams per 100 cubic centimeters 8½ hours after meals; blood urea, 33 milligrams per 100 cubic centimeters. The Wassermann and Kahn blood reactions were negative.

The patient was admitted to the hospital on October 17, 1927. At operation, on October 18, a longitudinal incision was made parallel with the right clavicle, and dissection was carried down to the tumor, which was found to be a well encapsulated structure, pyramidal in shape with the apex pointing upward. The tumor was movable but was attached at the apex to the median cord of the brachial plexus. At the base also it was attached to the prevertebral fascia lying in front of the sixth cervical vertebra (Fig. 11). The tumor was covered with a meshwork of nerve fibers. The carotid artery was superficial to the tumor. The tumor was dissected free and removed (Fig. 12).

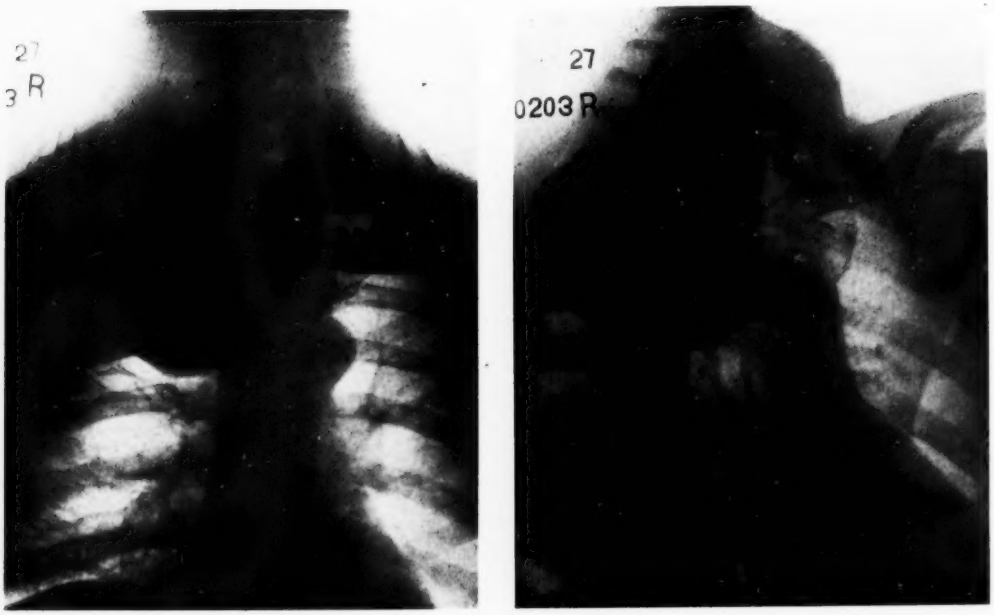
Convalescence was uneventful and no sympathetic nerve disturbances were noted except slight pain which radiated down the right arm on the fifth postoperative day.

Pathological report (Figs. 12–15): Ganglioneuroma and sympathicoblastoma.

HISTORICAL NOTES

The first use of the term neuroma to describe "deep seated tumors which are characterized by painful swellings of the nerve involved" was made by Odier in 1803 (Wahl). The first reference to the production of a tumor by hyperplasia of a ganglion was made by Gunsberg in 1845 (Spencer). In a tumor which was removed from the site of the gasserian ganglion and was described as being of the size of a pigeon's egg, ten to fifteen times the usual number of ganglion cells were found. In 1863 Virchow classified nerve tumors as false and true neuromata. Three types of true neuromata were described: (1) neuroma ganglio-cellulare, composed of ganglion cells with stroma, (2) neuroma fibrillare amyelinicum, composed of non-medullated fibers, and (3) neuroma fibrillare myelinicum, composed of medullated nerve fibers.

In 1870 Loretz reported the first case of ganglioneuroma, stating that he believed that the tumor arose from a prevertebral ganglion. In 1915 Dunn reviewed the literature on neuroblastomata and ganglioneuromata and



A. B.

Fig. 4. (Case 1.) A, Roentgenogram showing mediastinal tumor extending from above the sixth cervical vertebra to below the second anterior rib. Note the encroachment upon apex of right lung and deviation of trachea to left. B, Roentgenogram showing lateral view of tumor.

added 2 cases to the 49 previously reported. In only 12 of these cases were the tumors situated in the cervical or thoracic region, the majority being found in the abdominal segment. In 1914, Wahl reported a case illustrating the three types of nerve tumor which arise from the sympathetic system, and in his article he includes an excellent summary of the literature to that date. In Table I is given a brief summary of the reported cases in which the tumor occurred in the cervical and thoracic segments. Recently (1927) Thomas has reported the occurrence of a ganglioneuroma in the abdominal segment of a codfish.

HISTOGENESIS

It is presumed that the potential cell or group of cells which gives rise to a primary nerve tumor is carried from the ganglionic crest during the migration of the ganglia. This group of embryonic, undifferentiated cells may remain forever quiescent, or, at any period in the antenatal or postnatal development of the individual the cells may begin to proliferate. The resultant tumor will be composed of cells at various stages of differentiation, the stage of differentiation determining the degree of malignancy.

A working classification of these tumors should be based upon the cell types according to the stage of differentiation found, as has been done by Bailey and Cushing in their classification of the gliomata group. Such a classification can be made only by the examination of a large number of these tumors for different staining characteristics and by the study of the morphology of the cells. A modified, incomplete, schematic outline is shown in Table II, which will serve to illustrate the differentiation and the possible source of the tumor cells. The term neuroblastoma is not used because it is more general and should include any tumor of nerve cell origin.

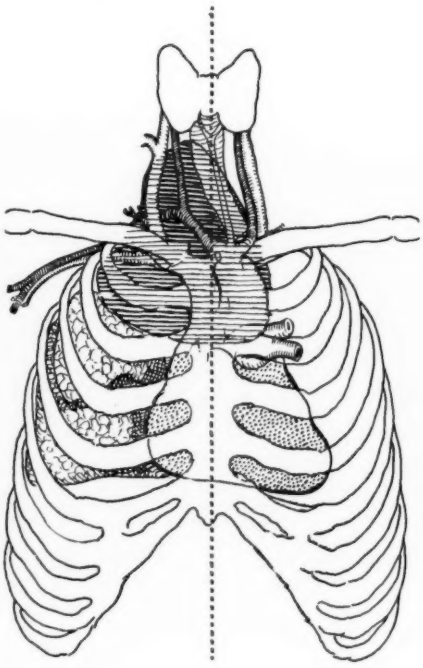


Fig. 5. (Case 1.) Sketch illustrating the position of the tumor. Note that the right subclavian artery and vein are surrounded by tumorous masses.

Fig. 6. (Case 1.) Mediastinal tumor removed at operation. Note the lobulation and network-like arrangement of tissue.

PATHOLOGY

In its gross appearance the sympathicoblastoma is usually a single, encapsulated tumor which is round or oval when it lies in soft tissue, and irregular in shape when it occurs in an area which will not permit symmetrical expansion. The tumor is covered with numerous nerve fibers, which are attached to a nerve cord or nerve plexus. The consistency of the tumor is soft. In color the cut surface is pale gray, mottled with pale yellowish areas. At the cortex is found a distinct zone which is firmer and blends with the central darker portion. On microscopical examination large numbers of small, round, and fusiform cells are revealed lying in a delicate reticulum, which supports numerous blood vessels. By special staining methods the cells are found to have the characteristics of embryonic nerve tissue.

The sympathicoblastoma is rarely composed of one type of cell but usually shows differentiated areas in which are found large, oval cells with abundant, faintly staining, clear cytoplasm and round, small, deeply staining nuclei. These are the ganglion cells which are found in the ganglioneuromata. They may be much larger and are sometimes four times the size of a normal ganglion cell of the cerebral cortex. The cells are apolar, unipolar, or bipolar. The stroma is a delicate, abundant, faintly staining structure, supporting numerous nerve fibrils which are myelinated or amyelinated. Sometimes the nerve fibers can be seen to terminate at the pole of a ganglion cell. This structure does not stain properly for neuroglial fibers.

The neurofibroma is stony hard, is usually lobulated, nodular, well encapsulated and has a striated, lusterless cut surface. Microscopical examination reveals linear deposits of

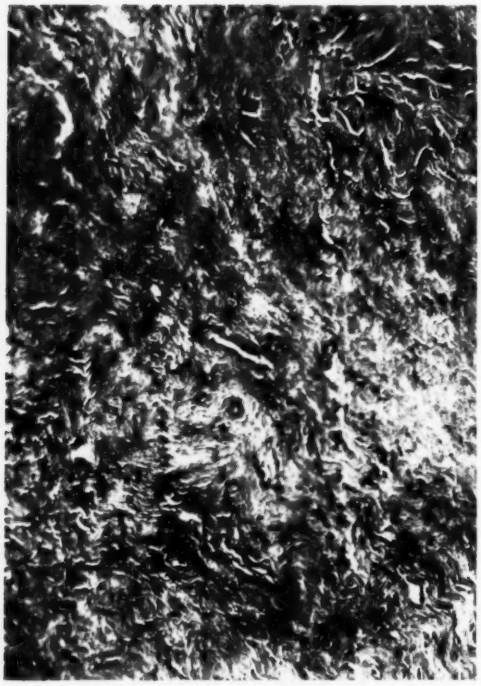


Fig. 7. (Case 1.) Photomicrograph (× 150) of neurofibroma showing round homogeneous acidophilic bodies.

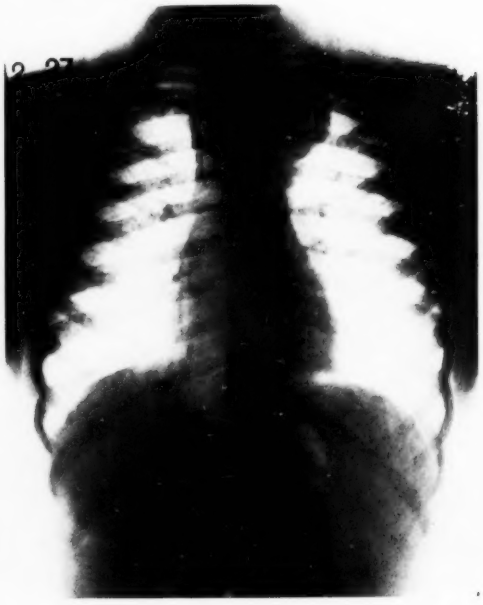


Fig. 8. (Case 2.) Roentgenogram showing dense anterior shadow extending from sternum to below the second rib. Note the displacement of trachea and œsophagus.

flattened, small cells with scanty cytoplasm which appear to be compressed between numerous bundles of elastic and collagenic fibrils. The adjacent lymph glands or organs do not show metastasis, except in the case of the undifferentiated types, namely, the neurocytoma or the sympathicoblastoma.

PATHOGENESIS

Dunn has summarized the pathogenesis of these tumors in his report of two cases, one of a blastoma in a boy 15 years of age and one of a ganglioneuroma arising from the adrenal glands in a child 4½ years of age. "The evidence available is such as to indicate that both forms of tumor are derived from residues of neuroblastic tissue, which have become dislodged from their natural place in the scheme of development of the nervous tissues. Where the residual cells retain their original embryonic form, a malignant tumor results. On the other hand, ganglioneuroma is not malignant. A focus may not differentiate and take on malignant character."

Often a single tumor shows different stages of differentiation, as occurred in our third case in which the tumor was both a sympathicoblastoma and a ganglioneuroma. It is easily conceivable that all stages of differentiation might be found in a single tumor.

That a tumor of one type may be transformed into one of another type is well shown in a case reported by Cushing and Wollbach. Wright has described what is probably the most malignant type, a type which is found in various organs, but this fact would suggest that these multiple growths are metastases rather than coincident multiple occurrences of primary tumors.

We place Ewing's neurogenic sarcoma in the position shown in the diagram because it is found in an undifferentiated state, and by comparison with the ganglion cell, the cell of the neurilemma might be thought to be

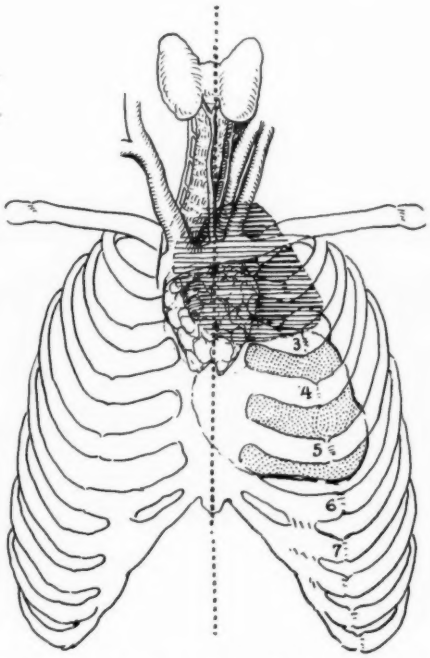


Fig. 9. (Case 2.) Sketch illustrating the position of the tumor. It was ovoid and extended from the thyroid gland downward into the chest.

Fig. 10. (Case 2.) Photomicrograph (× 250) of ganglioneuroma.

capable of the same kind of differentiation. This is purely hypothetical, however, although the neurogenic sarcomata are resistant to X-ray therapy and in this they simulate other nerve tumors.

The tumor which arises from the capsule of the ganglion cells has not, to our knowledge, been described. Sachs mentions 21 cases of tumors of the gasserian ganglion which he divides into two classes: (1) tumors which arise from the ganglion cells and (2) tumors which arise from structures of the dura, lying adjacent to the ganglion. In some of the tumors of his series the origin was very indefinite. On a histological basis, however, such a tumor is possible and probably has occurred.

DIFFERENTIAL DIAGNOSIS

Among the cases summarized in Table I there was a history of symptoms or of the presence of a tumor mass for a longer period of time than is usually associated with neoplastic growths in the neck or mediastinum, the longest duration—20 years—being reported in Case 17.

Pain is not a constant symptom, but when a tumor mass is freely movable and at the same time painful, close association with a nerve cord or plexus is suggested.

A substernal or intrathoracic goiter, more frequently than any other lesion, presents a clinical picture similar to that presented by a tumor of the type under discussion. In the presence of hyperthyroidism, of course, the mediastinal tumors are often mistakenly interpreted as adenomata of the thyroid gland.

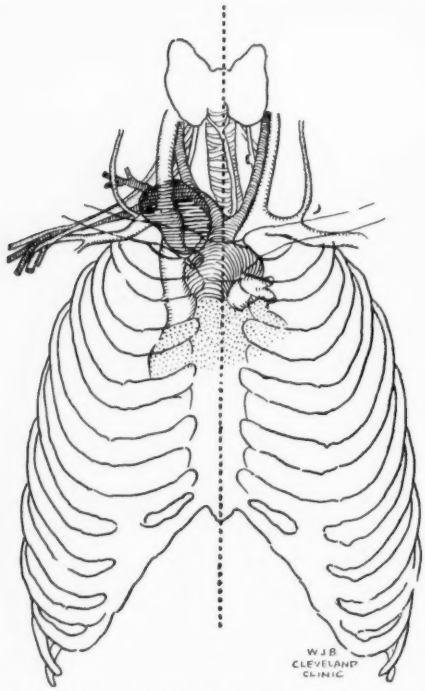


Fig. 11. (Case 3.) Sketch illustrating the position of tumor. It was attached at the apex to the median cord and at the base of the fascia in front of the sixth cervical vertebra.

A few objective signs might offer some aid in diagnosis. Unilateral sympathetic nerve disturbance is an extremely rare symptom of substernal goiter, but it is a not infrequent characteristic of a mediastinal nerve tumor (Abbe). The thoracic cage may be elevated or distended; and superficial veins may be present in the case of a tumor of either type.

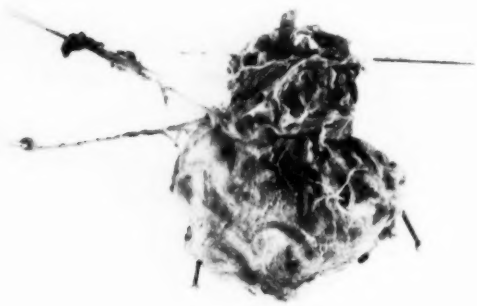


Fig. 12. (Case 3.) Photograph of tumor after excision showing meshwork of fibers.

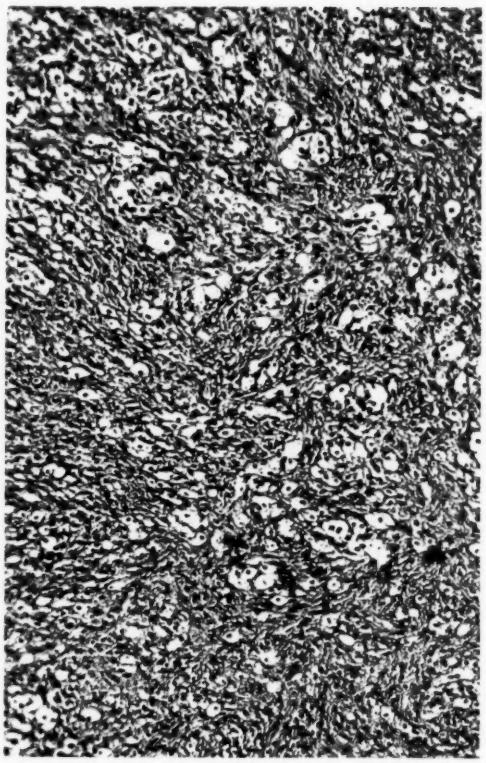


Fig. 13. (Case 3.) Photomicrograph (× 150) of ganglioneuroma. Specimen taken from central portion.

The roentgenogram offers possibilities of differential diagnosis but is not a means of certain differentiation. The majority of adenomata of the thyroid are situated anterior to the trachea, while a nerve tumor which arises from the prevertebral ganglia will necessarily be situated posterior to the trachea (Fig. 14). However, adenomata not infrequently encircle the trachea, and the largest portion of the growth may lie posterior to it. The trachea is displaced laterally in every case of nerve tumor (Figs. 4 and 8), because the ganglia lie at one side of it. The

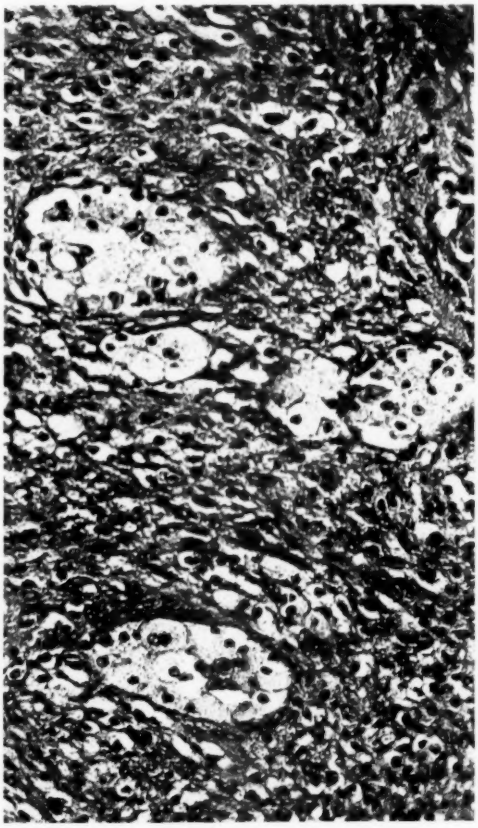


Fig. 14. (Case 3.) Photomicrograph (× 260) of ganglioneuroma. Specimen taken from central portion.

shadows are of uniform density and are ovoid, in contrast to the shape of a thymus-gland tumor, which conforms to that of the thymus.

Gibberd says that nerve tumors which are peripherally situated are of long duration and later are characterized by an increasingly severe neuralgic type of pain. These tumors have often been mistaken for enlarged lymph glands.

A clinical diagnosis of a mediastinal nerve tumor cannot be made with any degree of certainty. In the absence of hyperthyroidism, a history of long duration and the presence of a dense ovoid shadow posterior to the trachea are suggestive signs, particularly if there is a unilateral sympathetic nerve disturbance.

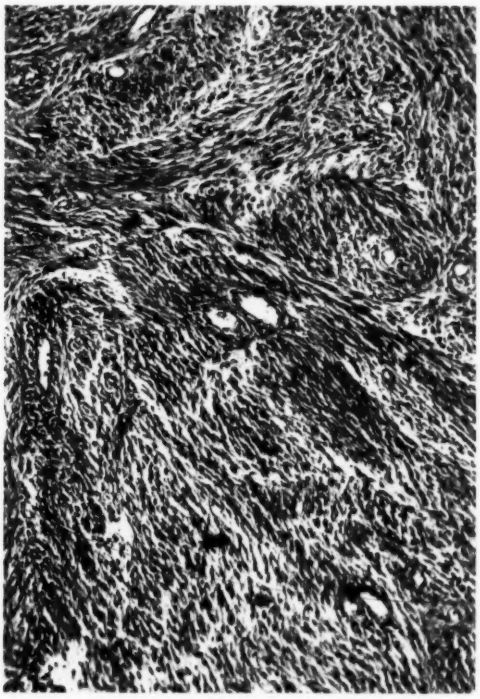


Fig. 15. (Case 3.) Photomicrograph (× 110) of sympathicoblastoma. Section taken from cortical area.

At operation the diagnosis can be fairly definitely made, as it is easy to rule out the thyroid as well as numerous other structures. The large number of nerve fibers extending from the tumor is almost pathognomonic of this type of tumor. The larger blood vessels are found to lie anterior to the tumor. If there is any doubt, a frozen section can be made and the diagnosis readily determined. The morphology of the ganglioneuromata is so characteristic that a frozen section stained with methylene blue is perfectly reliable.

TREATMENT

Surgical removal is the only treatment for this type of tumor, for radium and the X-ray do not stop its further growth. Since the tumors tend to increase in size and those of an undifferentiated type tend to metastasize, it is imperative that such a growth be removed early when it is situated in the neck or

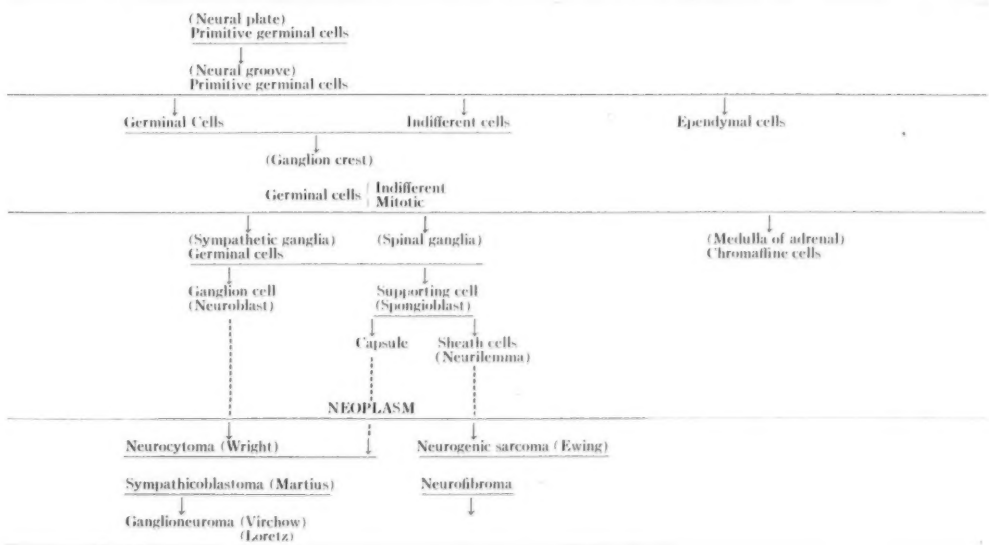
TABLE I.—SUMMARY OF REPORTED CASES OF TUMORS IN CERVICAL AND THORACIC SEGMENT

No.	Author and date of report	Age	Sex	Location	Duration and symptoms	Description of tumor	Remarks
1.	Loretz 1870	35	F	Superior mediastinum between second and third costal vertebræ on left side	Patient found unconscious. Specimen obtained at autopsy	The size of an egg, measuring 7.5 by 4.5 by 4.5 cm. The cortex is firmer than central area. It contains adult ganglion cells with medullated and non-medullated nerve fibers. Only unipolar nerve cells are found	Tumor believed to have come from prevertebral ganglia. First authentic case of ganglion hyperplasia.
2.	Borst 1897	?	?	Beneath pleura of left side of chest		Size of a child's head. Contains medullated nerve fibers	Tumor believed to have originated from sympathetic nervous system.
3.	Abbe 1898	9	F	Right side of neck, behind great vessels		A stony hard tumor, about 6 cm. in greatest diameter, with plexiform network of large nerve fiber bundles attached to it	
4.	Burghard 1900	44	M	Slightly to left of midline of neck	Pain and swelling of neck for 2 years. Very severe pain for past 6 months	Tumor mass measuring 3.8 by 1.5 cm. Fairly firm. It contains ganglion cells, nerve fibers, and myxomatous tissue	Complete recovery. Origin thought to be superior and mid-cervical ganglia which were involved in tumor.
5.	Benda 1904	? child		Deep in right side of neck		A single tumor. Non-medullated nerve fibers	Believed to have arisen from vagus ganglion.
6.	Glinski 1906	10	M	Left side of neck			Believed to have originated from sympathetic nerves.
7.	Woods 1906	32	M	Under right carotid sheath		Tumor weighing 180 gm. A single tumor measures 9 by 8 cm. The nerve fibers are non-medullated	
8.	Friedrich 1912	73	F	Anterior to spinal column at level of seventh thoracic vertebra		A single tumor, 7 by 2.8 cm., containing mostly non-medullated nerve fibers. Small round cells with glial ground substance	
9.	Freund 1913	5¼	M	Right side of neck, posterior to carotid sheath	Swelling of right side of neck for one year. Dyspnœa on exertion	A single lobulated tumor measuring 8.5 by 4.5 by 4 cm. A pale gray cut surface with whitish areas near center. The cells vary greatly in size; some apolar, unipolar, and bipolar cells being present. The stroma contains nerve fibers, non-medullated and medullated, and fibrous tissue	This case is believed to offer further proof that hyperplasia of the ganglion cells may occur.
10.	Martius 1913	2½	M	Right side of neck, attached to thyroid and enveloping carotid sheath, subclavian artery, superior vena cava, and right bronchus	Swelling of right side of neck for one year. Dyspnœa. Engorged veins on anterior chest wall	A lobulated and nodular tumor measuring 5 by 3 by 1.5 cm. The cells are large with scanty cytoplasm and large vesicular nuclei	Patient died shortly after partial removal of tumor. Middle cervical ganglion was incorporated in tumor growth and nerve fibers.
11.	Geymueller 1919	5	M	Between mastoid process and upper cervical vertebræ	Enlargement of neck which was thought to be lymph gland	Well encapsulated oval tumor containing ganglion cells and numerous non-medullated nerve fibers	Growth was easily removed.
12.	Sommerfelt 1920	36	F	Neck, beneath mandible, in region of submaxillary gland and superficial to great vessels	Enlargement of neck for 4 years. At first thought to be lymphatic gland enlargement	A single tumor the size of a goose egg. Sections show adult ganglion cells, medullated and non-medullated nerve fibers. Round cells (neurocytes) present	Tumor believed to have arisen from submaxillary ganglion.
13.	Anderson and Sherman 1923	13 wks.	F	Beneath pleura on side, attached to second and third ribs		A single tumor measuring 4.2 by 2.8 cm. Various types of cells ranging from undifferentiated small round cells to ganglion cells. Rosette formation	

TABLE I.—*Continued*

No.	Author and date of report	Age	Sex	Location	Duration and symptoms	Description of tumor	Remarks
14.	Rosenson 1923	8	F	Right side of upper part of posterior mediastinum	Cough, loss of weight, vomiting, and irregular fever. Flatness of right side with diminished breath sounds, bronchial breathing with absence of fremitus	Tumor the size of a tennis ball, with smaller attached mass below it. Ganglion cells present	Horner's symptom-complex developed during convalescence.
15.	Gibberd (Case I) 1924	37	M	Left side of neck beneath sternomastoid muscle, behind bifurcation of carotid artery	Aching pains in left side of neck for 15 months. Palpable tumor, movable only from side to side	A single tumor 4 cm. in diameter, composed of dense stroma without ganglion cells	Following operation, enophthalmus with sweating on left side.
16.	Gibberd (Case II) 1924	32	M	Left side of neck beneath sternomastoid muscle	Small tumor mass, movable only in lateral direction. Two years' duration	A single firm tumor, size of a walnut. No ganglion cells present	No sympathetic disturbance following operation.
17.	Crile and Ball (Case I) 1928	8	F	Superior and posterior mediastinum and right side of neck	Tumor mass in right side of neck for 20 years. In past three years, shortness of breath and sensation of pressure in chest	A lobulated, firm, encapsulated, and nodular tumor weighing 550 gm. and measuring 15 by 11 by 8 cm. No ganglion cells demonstrable	Autopsy obtained. (See case report.)
18.	Crile and Ball (Case II) 1928	8	F	Superior mediastinum, extending into neck	Tumor mass in superior mediastinum about 1 year. Difficulty in breathing for 6 months and brassy cough and audible breathing for 3 years	A single, soft, smooth, oval tumor about 11 cm. in greatest diameter. Apolar and unipolar ganglion cells present.	See case report.
19.	Crile and Ball (Case III) 1928	40	F	Right side of neck presenting in supraclavicular fossa	Tumor mass present for past 3 years. Moving tumor caused pain to radiate down right arm	A single, oval, encapsulated soft tumor measuring 50 by 40 mm. Composed of ganglion cells andundifferentiated round cells with rosette formation.	See case report.

TABLE II.—DIFFERENTIATION AND POSSIBLE SOURCE OF TUMOR CELLS



mediastinum. Operation should, therefore, be performed at the earliest possible date because of the tendency of the tumor to grow around the large blood vessels or other tubular structures, thus making a later removal a much more extensive operation or in some cases an impossibility.

SUMMARY

1. Three primary nerve tumors in the neck and mediastinum are reported. and an analytical chart of all similar cases reported in the literature is offered.

2. These tumors are believed to arise from cells which have migrated from the ganglionic crest with the ganglia.

3. Only tumors of the earliest undifferentiated type are ever malignant, and this type tends to become increasingly differentiated until it reaches the adult stage, when it becomes a benign type of tumor.

4. Diagnosis is difficult, but if the tumor is definitely located and the duration of the symptoms is considered, a correct diagnosis is more likely to be made.

5. The early diagnosis and the immediate removal of the tumor is indicated because of the tendency of the neoplasm to continue to enlarge, to envelop surrounding structures, and possibly to metastasize—if it is a tumor of the undifferentiated type.

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THE IMPORTANCE OF THE VESSELS IN THE ROUND LIGAMENT TO THE HEAD OF THE FEMUR DURING THE PERIOD OF GROWTH, AND THEIR POSSIBLE RELATIONSHIP TO PERTHES' DISEASE[1]

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THE theory that occlusion of the vessels coursing through the round ligament causes the femoral head changes that characterize Perthes' disease is not a new one. It was first suggested by Schwartz, a pupil of Perthes in 1914, four years after the original description of the disease, and it was based upon exhaustive clinical and roentgenological examinations. At that time, however, very few pathological specimens of the disease had been available for study and, as a consequence, there was considerable diversity of opinion regarding the findings that constitute the essential criteria of the disease. It was probably because of this inadequate background that Schwartz's idea received only scant attention.

Since 1914, the study of considerable additional pathological material has served to clarify in great measure our conception of the disease picture. It is now generally accepted that the microscopic criteria of Perthes' disease consist essentially of massive subchondral bone and marrow necrosis with marrow replacement by vascular granulation tissue. That these changes resemble closely those of healing infarction, has been noted by Axhausen, Bergmann, Nussbaum, Zemansky, and others, and this fact has lent support to the vascular occlusion theory.

Aside from the many clinical and pathological aspects of the problem, it is apparent that the plausibility of Schwartz's theory depends directly upon whether, normally, the round ligament vessels are of importance to the nutrition of the adolescent femoral head. The importance of these vessels in this regard has been much questioned and constitutes the subject of this paper.

As Kolodny has demonstrated, the adolescent femoral head is supplied with blood vessels of three categories: (1) blood vessels coming from the diaphysis of the femur, (2) epiphyseal blood vessels, and (3) blood vessels carried by the ligamentum teres femoris.

The vessels of group 1, representing the end branches of the superior nutrient artery, perforate the epiphyseal plate and enter the femoral head. Inasmuch as these vessels are only occasionally observed, it is generally granted that their importance to the femoral head is insignificant.

The vessels of group 2 enter the head along the edge of the articular surface. They are certainly the main source of nutrition to the periphery of the nucleus. As we hope to show later, they are not of equal importance to the center and crest of the structure.

This central region and crest is directly entered by the round ligament vessels (group 3), after they penetrate the cartilage at the fovea capitis.

It is generally believed that the nutrition from this group is not of much significance to the femoral head, and that if, for some reason, the circulation through them is impaired, adequate collateral circulation from the epiphyseal branches will replace it. The literature, however, reveals that the importance of these vessels has been a matter of controversy since their original description by Paletta in 1820.

Paletta described a small artery, a branch of the obturator artery which perforates at the site of the incisura acetabuli and then splits into two branches—one for the acetabular fossa and one for the round ligament. The latter branch courses through the round ligament to supply blood to the femoral head.

In 1844, Sappey wrote that the function of the round ligament was purely that of protection for this artery. Two years later, however, Hyrtl announced that this was incorrect and that he had shown by injections that the vessel failed to enter the spongy bone; that it anastomosed through capillaries with the venous system without entering the femur.

[1]Presented before the New York Pathological Society, October 11, 1928.

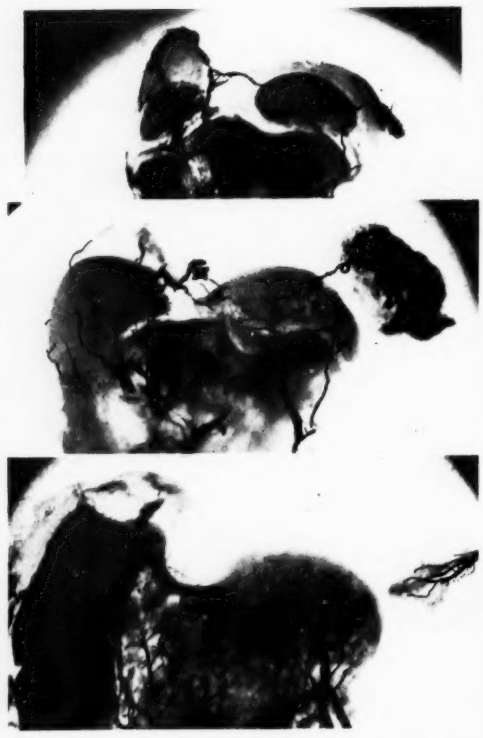

Fig. 1. A, Photograph (retouched)[1] of the cleared upper femur of a rabbit 2 weeks old injected with bismuth, showing the arteries supplying the capital nucleus. The round ligament supply is prominent at this age. B, Photograph (retouched) of the cleared upper femur of a rabbit 5 weeks old prepared as was that of Figure 1A. The diminution of the area supplied by the round ligament vessels, and the increased area cared for by the epiphyseal branches is evident. C, Photograph (retouched) of the cleared upper femur of a seven weeks old rabbit with injected arteries. The round ligament vessels are no longer of sufficient patency to admit the injecting fluid.

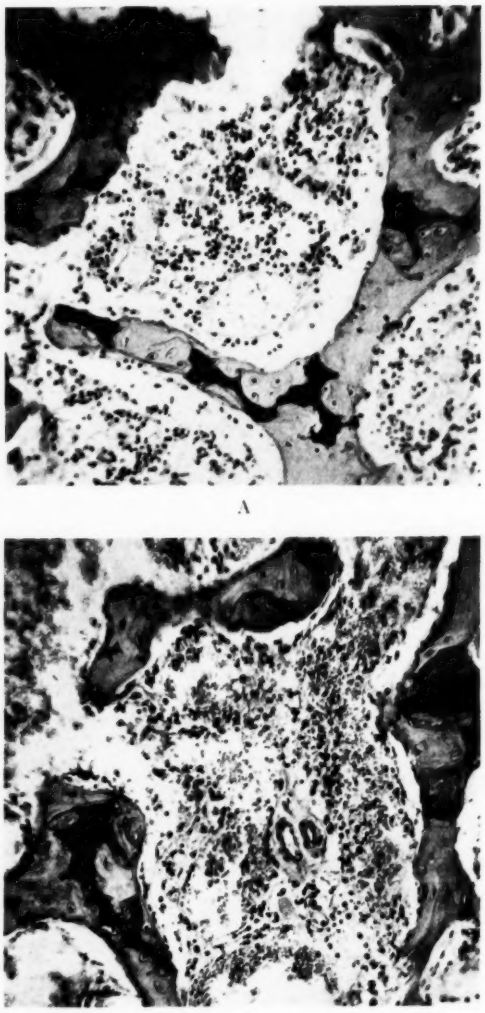

Fig. 2. A, Section of the femoral head nucleus removed from rabbit one 6 days after operation. Note the anæmia, the diminished number of osteoblasts, and the beginning necrobiotic changes in the marrow cells. B, Opposite normal for comparison with preceding illustration.

Luschka mentions that he never failed to observe branches entering the bony femoral head, and Henle wrote that the function of the round ligament was nutritive, but he expressed doubt as to whether the vessels communicate with those of the femur.

Langer studied these vessels carefully and, in his paper, "Ueber das Gefasssystem der Rohrenknochen," concluded as follows: "In children, there is a constant branch of the obturator artery which proceeds along the round ligament and enters the still cartilaginous head where it branches to meet those vessels entering about the joint periphery. Anastomosis occurs when calcification begins. . . . Also in adults, I have been successful

[1] Owing to the tortuosity of the injected vessels, it was impossible to photograph them without blurring. For this reason, they were retraced with ink.

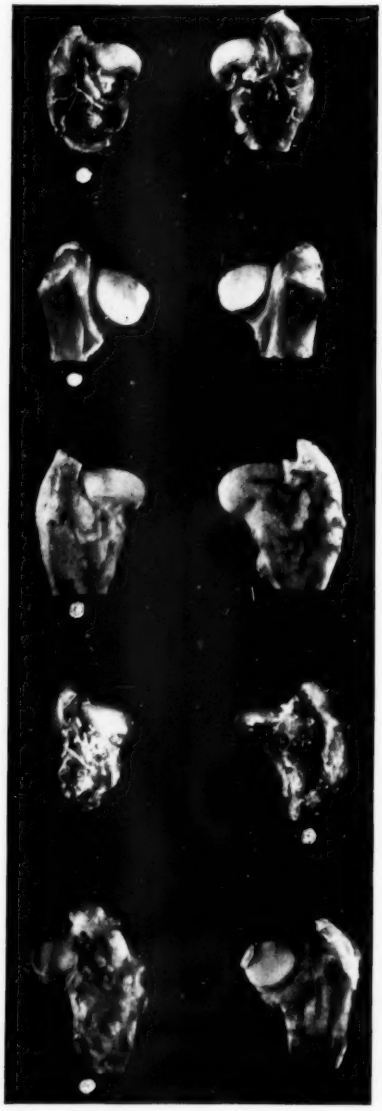

Fig. 3. The upper femora of rabbits three, four, five, six, and seven, showing progressive gross deformation. (Dot marks the femur of the side operated upon.)

in identifying the artery that courses through the ligament." Langer believed that the vessels were of great importance, but only until the establishment of the bony nucleus.

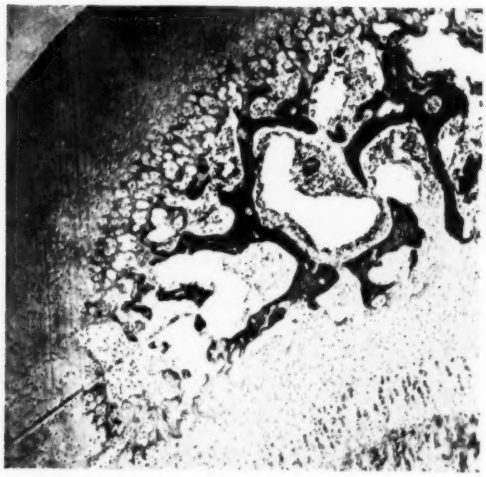

Fig. 4. Rabbit killed 9 days after operation. Note the necrosis of the anterior portion of the bony nucleus and, in the most anterior part, the new-growth of fibrous tissue.

Moser's paper, "*Ueber das Ligamentum Teres des Hueftgelenks*," is probably the most significant contribution to the subject. Moser made serial sections of femoral heads in all stages of fetal life and in children up to four years of age for the purpose of studying the blood supply. He discovered that in 12 centimeter embryos, the vessels from the round ligament can first be identified in the cartilage. They can be seen to persist there until at least the fourth year of life. At this point, because of technical difficulties, Moser was unable to continue his studies. In contrast to Langer, Moser was not convinced that the function of these vessels ceased when the bony nucleus became established. He wrote: "Later, most of these vessels unquestionably atrophy. . . . In adults, I have found vessel openings in the fossa capitis only in half the specimens and whether these openings still contain active blood vessels is doubtful in that the canals may persist for a while after obliteration of the vessels. . . . We may conclude that, *in adults*, the blood supply through the round ligament can be entirely dispensed with."

More modern methods of anatomical study such as injection with opaque solutions followed by roentgenography (Lexer) or clearing

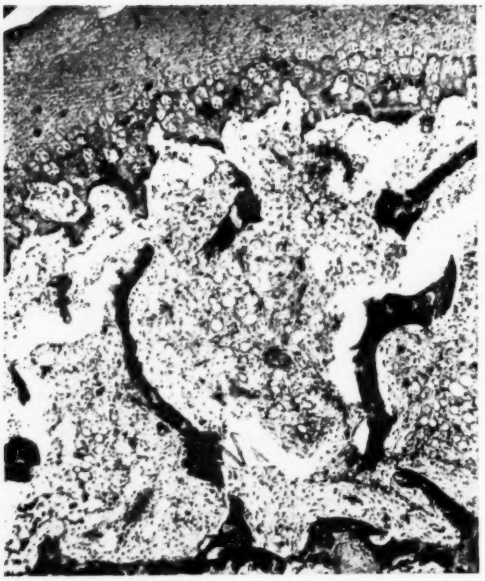

Fig. 5. Rabbit four (12 days after operation) showing marrow fibrosis and bone necrosis.

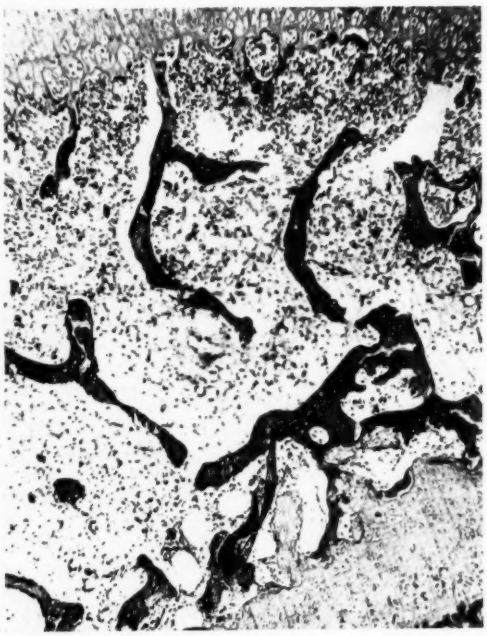

Fig. 6. Rabbit five (18 days after operation) showing changes similar to those observed in the preceding rabbit.

(Spaltcholz) have, in the hands of many observers, substantiated Moser's conclusions regarding the course and duration of patency of these vessels. Nevertheless, as late as 1907, Fick wrote that a large blood vessel had never been seen in the round ligament and that the importance of this blood supply was unquestionably negligible.

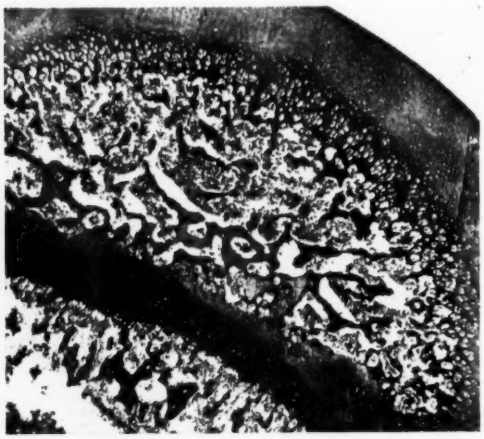

Fig. 7. Rabbit six (27 days after operation) showing predominance of cartilage over bone, thickness of the surface cartilage, and filling of marrow cavity with débris.

Fig. 8. Rabbit seven (36 days after operation) showing, in addition to the previously observed changes, the collapse of the nucleus.

In the most recent anatomical study of the femoral head circulation, that of Kolodny in 1925, it was concluded: "The blood vessels brought to the head of the femur in the ligamentum teres femoris play a certain rôle in the nutrition of the femoral head in newborn and child but are of no perceptible importance in the nutrition of the femoral head of the adult."

Thus, anatomical studies have definitely established that, in the adolescent, the femoral head is nourished by the round ligament vessels. The importance to the femur of this nutritional source, however, remains undetermined.

One effort to ascertain whether in animals section of the round ligament and the consequent obliteration of the vessels coursing through it causes noticeable changes in the femoral head was found in the literature. Iselin in 1918 sectioned the round ligament of the hip joint in a series of dogs. The hips of the animals were X-rayed at periodical intervals thereafter. Iselin could discern no X-ray changes and concluded that the round ligament vessels were unimportant to the femoral head. Unfortunately, the report of these experiments fails to mention the age of the dogs that were operated upon, and it is thus impossible to evaluate his work correctly.

Some insight into the fact that these vessels are not entirely of negligible importance may, however, be gathered from the experiment of Bergmann in 1927. In one young rabbit, Bergmann sectioned the epiphyseal blood supply to the head by cutting through the covering of the femoral neck for three-quarters of its circumference. In another animal, the same operation was performed but, in addition, the round ligament was cut. On examination, the first specimen showed widespread necrosis of the head but less necrosis than was present in the specimen from the second rabbit. In other words, necrosis of the head was more extensive following section of the round ligament than when it was left intact. Bergmann did not attempt section of the ligament alone.

From this brief summary of the literature concerning the round ligament vessels, it is apparent that considerable diversity of opinion exists regarding their importance to the femur. In the hope of obtaining a clearer conception of their function in this regard, especially during adolescence, the following experiments were undertaken.

A preliminary series of dissections in rabbits showed that the developmental stage of the capital epiphysis in animals 2 weeks old corresponds approximately to that of children 4 years old. These dissections further demonstrated that, in these animals, the femoral head unites with the shaft at about the age of 7 weeks (18 years in the human). With regard to this epiphysis, then, the span of life between the ages of 2 and 7 weeks in these animals corresponds roughly to that between 4 and 18 years in the human being, the age period during which Perthes' disease occurs.

A subsequent series of arterial injections, according to the method of Gross, has demonstrated that, in rabbits of these ages, the vascular arrangement is not dissimilar to that of the human femur at a corresponding age. In Figure 1A, a photograph of a typical 2-weeks-old specimen, a comparatively large artery can be seen which, after coursing through the round ligament, penetrates the cartilage to supply the central area and crest of the nucleus while the periphery and base are cared for directly by the epiphyseal vessels.

Figure 1B, the femoral head of a rabbit, 5 weeks old, shows well the diminution in size and importance of the round ligament vessels at this age. By far the greater part of the nuclear nutrition is, at this age, derived from the epiphyseal vessels.

Injections of the arterial trunk in rabbits 7 weeks old and older (Figure 1C) demonstrate that the femoral head is nourished entirely by the epiphyseal arteries. The vessels that course through the round ligament at this age have ceased to enter the bony head and terminate before the ligament reaches the fovea capitis.

It may be concluded from this series of arterial injections that, in rabbits, the blood supply from these vessels to the femoral head gradually diminishes and ceases completely when the epiphysis unites with the shaft. It

cannot be stated with certainty that the round ligament vessels of the human cease to furnish blood to the femur at the same relative developmental stage. However, inasmuch as all anatomical evidence indicates that these vessels usually are completely closed in human adult life, it is most likely that a similar condition exists.

With these facts in mind, we have sectioned the ligamentum teres on one side in a series of rabbits 2 weeks old, thereby obliterating the circulation through it to the femoral head in order to determine the effect of this procedure on the developing capital nucleus.

PROCEDURE[1]

After morphinization, the animals were etherized and prepared for operation in the customary manner. A three-quarter inch incision, posterior and parallel to the greater trochanter, was made and the fibers of the gluteus maximus muscle exposed. These were separated in the line of their course by blunt dissection and retracted together with the sciatic nerve which lies directly underneath. The small external rotator muscles were then sectioned and the underlying joint capsule incised along the border of the acetabulum.

By adduction and inward rotation of the thigh, the point of attachment of the round ligament to the femoral head was presented to view and, with a small, sharply curved scissors, the ligament was sectioned at this site. Closure was effected by means of silk muscle and skin sutures followed by a collodion dressing.

Eighteen rabbits, 2 weeks old, were so operated upon. Four of these rabbits died during or immediately after the operation and were consequently discarded. Four others were excluded because at autopsy it was found that the operative procedure had caused luxation of the hip. Two of the rabbits were excluded because of purulent infection at the operative site. In one rabbit, the femoral head was injured during operation and the specimens from this animal were also excluded from the series. Studies of the remaining seven rabbits constitute the following report.

The specimens from these animals were examined 6, 9, 12, 18, 27, and 36 days after operation.

CONTROLS

In order to ascertain whether or not round ligament section was responsible for the ensuing pathological changes, the identical procedure was performed on the opposite hip of the experimental rabbits, but the ligament, after exposure, was allowed to remain in the hip joint untraumatized and uncut. In none of these control specimens was there any gross or microscopic change detectable in the femoral head.

In order to establish that the changes were due to obliteration of the blood vessels rather than other complications of the operation, three rabbits, 7 weeks old, were operated upon in a like manner. In rabbits of this age, as our injections have demonstrated, the round ligament vessels no longer enter the femoral head. Careful examination of the hip joints in these rabbits up to 5 weeks after operation failed to disclose any abnormality resulting from the operation.

It is thus safe to conclude that changes resulting from the operation are due to interruption of the circulation through these vessels.

EXPERIMENTAL RESULTS[2]

Rabbit one of this series was killed 6 days after the operation. No gross changes were demonstrable, but microscopic sections of the femora obtained were instructive in illustrating the extent of the anæmia resulting from the operation.

Section of the capital nucleus on the side operated upon shows that although blood cells can be seen in the region directly overlying the epiphyseal plate and in that portion closest to the trochanter, the remaining marrow of the nucleus is almost completely anæmic. This area, in which red blood cells can be found only with the greatest difficulty, is in striking contrast to the corresponding region in the section of the opposite femur. This area is well filled with blood as are all other bony areas apparent in the sections. Figure 2A taken from the capital nucleus on the normal side shows the usual number of blood cells filling the capillaries. Figure 2B illus-

[1] The specimens for microscopic examination were fixed in formalin and decalcified by the customary method, in nitric acid. Microscopic sections were cut in a vertical plane running through the mid-trochanteric area and the center of the fovea capitis. They were stained with hematoxylin and eosin.

[2] In order to facilitate description of the microscopic specimens, the region of the nucleus closest to the fovea capitis will be termed "anterior." That portion closest to the trochanter will be referred to as "posterior."

trates the sparsity of these cells in the affected area. It is apparent from Figure 1A that the anæmic area corresponds well with the region that, at this age, is directly nourished by the round ligament vessels.

Aside from the anæmia of the side operated upon, there is perhaps a slight diminution in the number of osteoblasts bordering the bony lamellæ. On examination with the high power, several nuclei of the marrow reticular cells and those of the blood forming cells show evidence of necrobiosis, namely, pyknosis, kariorexis, kariolysis; otherwise no changes were noted.

Rabbit two, also killed 6 days after the operation, showed changes so similar to those of rabbit one that they do not warrant a separate report.

Rabbit three, killed 9 days after operation, showed a slight flattening of the femoral head on the side operated upon. In Figure 3 this deformation is apparent. On longitudinal section of the nucleus on this side the entire bony portion appeared pale, and there was a small area of yellowish discoloration directly beneath the collapsed portion of the surface.

Microscopic examination disclosed that the surface and epiphyseal cartilages were well stained and intact. The bony lamellæ, posteriorly, contained approximately the normal number of well stained bone cells. The marrow of this region as well as the endosteum appeared also to be intact. In the central portion of the nucleus there were more empty bone lacunæ to be seen, the osteoblasts were fewer in number and, in the upper part, a collection of débris was apparent which consisted of necrotic hæmogenic cells. The position of this necrosis corresponded to the area of yellowish discoloration seen on gross section. The anterior third of the nucleus (that closest to the round ligament) appeared completely necrotic. All of the bone lacunæ in this area were empty, no osteoblasts could be found, and the marrow tissues were very poorly stained. In the most anterior portion, there could be seen a small area of beginning fibrosis. Figure 4 illustrates this finding.

Rabbit four died on the twelfth day after operation, of inanition. The femoral head on the side operated upon was flattened as in the preceding specimen, and this deformation was more marked. In addition to the flattening, the head had assumed a "mushroomed" contour suggesting that of true Perthes' disease (Fig. 3).

On gross section the changed contour of the nucleus was still more apparent. There was considerable diminution in its height as well as increase in its lateral diameter. The entire nucleus was paler than that of the opposite side, and the region underlying the crest was yellowish in color as in the preceding rabbit.

Microscopic section showed, as before, the surrounding cartilage to be well stained and containing normal looking cells. The area of nuclear necrosis, which in the preceding specimen was confined to about one-third of the total area, occupied here over half the structure. The bony lamellæ of the anterior and upper portion contained many empty bone lacunæ, although posteriorly and directly above the epiphyseal line the bone cells were well stained. Osteoblasts in the affected area were present, but the number of them was definitely diminished. The marrow in this area was anæmic and completely fibrotic. Centrally, there could be seen a large area of hæmogenic cell débris corresponding to the yellow area that was apparent on gross section (Fig. 5).

Rabbit five, killed 18 days after the operation, showed, grossly, still more flattening than the preceding specimen, although its general shape was less "mushroomed" and more in conformity with the normal. The surface cartilage was ridged anteroposteriorly with a shallow groove which can be seen well in the illustration (Fig. 3).

On gross section of the specimen, the entire nucleus was paler than that of the opposite side, and, as before, the area underlying the crest was of a yellowish color. The bony nucleus was decidedly smaller in size than that of the opposite side, and the layer of cartilage surrounding it was considerably thicker.

Microscopically, although the specimen was very similar to that of rabbit four, the area of marrow débris was larger, and anteriorly the endosteal cells were still fewer in number and a larger relative number of bone lacunæ were empty. The posterior and lower portions of the specimen were intact. The surface and epiphyseal cartilages appeared thickened but otherwise normal.

Rabbit six died on the twenty-seventh day after operation, of inanition. Autopsy disclosed that the femoral head on the operated side was considerably smaller than that of the opposite member. It was slightly bluish in color and marked with a deep transverse furrow. A mild degree of coxa vara was present and can be seen in the illustration (Fig. 3).

On gross section the bony nucleus was approximately one-half the size of the opposite control though the layer of surrounding cartilage was thicker. The entire nucleus was grayish yellow in color.

Microscopically, the cartilage was normally stained but considerably thickened. The marrow cavity throughout the section was filled with a mass of débris consisting largely of necrotic and poorly staining round cells. The reticulum and endosteum could be identified only in a few small places lying directly above the epiphyseal plate. The bony lamellæ, which in the opposite normal consisted almost entirely of calcified bone, were in this section largely cartilaginous. In the anterior and upper sections practically no true bone was seen and normal lamellæ could be found only at the base and posterior portions of the section. The bone cells themselves were perhaps better preserved than in the preceding sections though the greater part of the lacunæ were either empty or contained pyknotic cells (Fig. 7).

Rabbit seven died on the thirty-fifth day, of inanition. Autopsy showed the femoral head on the side

operated upon to be about one-half the size of the normal. The head was markedly flattened and there were two deep transverse furrows. In the region of the fovea capitis the surface cartilage was pitted in several places (Fig. 3).

Gross section showed, as before, the bony nucleus to be about half the size of that of the opposite member and surrounded with a much thicker cartilaginous shell. It was of yellowish color and of chalky consistency.

Microscopically, the cartilage was normal in staining qualities but somewhat thickened. The marrow cavity of the posterior portion and upper region contained a large mass of cellular débris. Even the reticulum was unstained in these areas. Anteriorly, the fibrous stroma appeared well stained, and round cell elements were completely lacking in this area. Throughout the specimen many small hæmorrhagic clusters of red cells occurred. None were seen in the marrow capillaries, which, as in the previous specimens, were empty. Osteoblasts were completely absent from the specimens except along the margins of the lowermost bone lamellæ where many of them could be seen. The bony lacunæ were almost entirely empty, with the exception of a few small areas in which well-stained bone cells occurred. These areas were in the lower and posterior parts of the section. Figure 8 shows in addition the indentation of the fovea capitis which rests close to the epiphyseal plate.

SUMMARY

The femoral head changes thus observed following round ligament section in rabbits 2 weeks old may be classified as follows:

1. *Anæmia.* Anæmia of the anterior portion and crest of the nucleus was observed first in the femoral heads of the two rabbits killed on the sixth day. Anæmia of this area characterized also all of the subsequent specimens observed.

2. *Signs of bone necrosis.* Pyknosis and failure of the bone cells to stain in the anæmia area was first observed in the 9-day specimen. The number of the bone cells thus affected increased in the later specimens until we find in the specimen taken 22 days after operation that practically the entire anæmic area contains only empty cell lacunæ.

3. *Marrow necrosis.* Necrobiosis was observed to occur in the marrow cells of the specimens taken after 6 days. Failure of the hæmogenic elements to stain and incipient marrow fibrosis were first apparent in the 9-day specimen. Necrosis of the marrow stroma was first observed in the 22-day specimen.

4. *Signs of cessation of ossification in this area.* Grossly, the relatively smaller size of the bony nucleus was first apparent in the 18-day specimen. The thickening of the surrounding cartilage and the increased proportion of unossified cartilage in the bony lamellæ of the nucleus could be seen microscopically in the same specimen and in all those subsequently observed. The diminution in number of the osteoblasts was first apparent in the 9-day specimen. In the last three specimens, no osteoblasts were identifiable in the affected area.

5. *Gross deformation of the femoral head.* Flattening of the weight-bearing area and ridging occurred first in the 9-day specimen. The later specimens show in addition pitting and furrowing of the surface. Microscopically, the cartilage of this area is well stained and intact.

6. *Coxa vara.* First apparent in the 18-day specimen and present in all the subsequent ones.

The fact that the changes mentioned were, in all the specimens, associated with anæmia, and the resemblance of these changes to those of infarction suggest strongly that they are due to the circulatory interference of the operation. When it is considered that the affected area is at this age period directly supplied by the vessels of the ligamentum teres (as our injections have shown) and that the changes fail to appear when the operation is performed after the vessels have closed, there can remain little doubt that the pathological picture results from obliteration of the round ligament circulation alone.

The patchy hæmorrhagic areas that were observed in the specimen of rabbit six as well as the round cell marrow infiltration seen in rabbit seven cannot be regarded as characteristic findings, in that they were each observed in one specimen only. Moreover, similar changes to these are not infrequently found in areas of infarction in other regions of the body and indeed, they have been described as occurring in true cases of Perthes' disease (Riedel, Walter).

The access of migratory cells to the area of infarction may be explained by the fact that while the round ligament arteries are func-

tionally end vessels, capillary anastomoses between them and the peripheral epiphyseal branches do exist. While apparently these anastomoses are adequate to carry blood cells to the infarcted tissues, the above experiments have shown that they are insufficient to preserve the viability of the affected area.

CONCLUSIONS

It may thus be concluded from these experiments that the vessels of the round ligament are essential, at least in rabbits, for the normal development of the femoral head; and that interference to the circulation through them at an early age produces an anæmia of the weight-bearing portion of the capital nucleus, which, in turn, causes bone and marrow necrosis with ensuing secondary deforming changes.

Furthermore, our studies have demonstrated that, as adolescence progresses, the importance of these vessels gradually diminishes until the epiphysis unites with the shaft, at which time in normal animals, the vessels no longer carry blood into the femur and the nutrition of the crest is derived entirely from below.

It is reasonable to suppose that a similar replacement occurs in the human at the same relative age period, i. e., the period during which Perthes' disease appears. If this supposition is correct it is not unlikely that the immediate cause of the disease lies in some maladjustment of the delicate physiological balance that must exist between these sources of nutrition to the crest of the femoral head.

Whether the changes produced in the femora of our experimental rabbits are analogous to those of early Perthes' disease cannot, at the present writing, be established with certainty. However, the similarity of the experimental specimens to those of real Perthes' disease that have been observed is striking. While the experimental specimens have not shown the vascular granulation tissue that characterized most of the studied examples of the true disease, it should not be forgotten that this granulation tissue may well be a healing phenomenon and, therefore, late in appearing. Whether this tissue will occur in the femoral heads of rabbits permitted to live a post-operative course longer than 35 days, remains to be determined by a continuation of this series of experiments.

We wish to express our gratitude to Dr. Louis Gross, director of the Pathological Laboratory, Mount Sinai Hospital, and Dr Paul Klemperer, pathologist to the hospital, for their careful revision of this work.

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CHANGES IN THE INTESTINAL FLORA AFTER GASTRO-ENTEROSTOMY AND PARTIAL GASTRECTOMY

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GASTRIC surgery has made many advances during the recent years with a tendency to more extensive stomach resections for gastric and duodenal ulcers. However, the majority of surgeons still prefer the less radical procedures of gastro-enterostomy and pyloroplasty for peptic ulcer and more especially for the duodenal variety. A solution of the problem involved in this article was sought after a study of the results obtained by S. A. and B. Portis in their work described in their article entitled "Effects of Subtotal Gastrectomy on Gastric Secretion" (10). In this article it was shown that the stomach remaining after subtotal gastrectomy still continued to secrete free hydrochloric acid, which could be demonstrated in a Pawlow pouch contiguous with the main body of the stomach. However, the gastric contents from the stomach itself showed an achlorhydria. In the present study we have endeavored to learn the possible effects on the upper intestinal flora of an absence of free gastric acidity.

LITERATURE REVIEW

Various methods have been used in clinical and experimental studies of the bacterial flora of the intestinal tract. The method described by Arnold was the one found most suitable in this study and will be discussed under technique.

The relationship of the acidity of the stomach and duodenal flora has been considered by numerous men with especial reference to various diseases of the body and alimentary tract, especially with reference to pernicious anæmia. In a very careful study of the relationship of the hydrogen-ion concentration and the bacterial flora, Arnold and Brody (2) conclude that when the normal reaction of the contents of the duodenum and upper jejunum is changed from slightly acid (Ph 5-Ph 6) to a neutral reaction (7-8) there is a moderate change in the bacterial flora in this part of the intestinal tract, but when they become alkaline, the resultant flora resembles that of the lower ileum and the colon. Furthermore, the maintenance of a normal hydrogen-ion concentration was dependent to a great extent on the normal gastric secretory function. In a study of 100 cases of gall bladder disease, in which cultures were taken of the duodenal contents and correlated with its acidity, Hedy found the flora richer with decreasing acidity of the duodenum. Bitter and Lohr, in examining the bacterial flora of the stomach and upper small intestine in 190 patients after various gastric operations, found that gastric acidity is of great importance in the control of the bacterial growth in these regions, and coincident with a decrease in the acidity, the large intestinal flora gradually encroaches on the small intestine, and in achylia these fæcal bacteria may even reach the stomach. Ricen, Sears, and Downing made similar observations in 30 cases of achlorhydria in which the duodenal content was rich in bacteria, many of which had blood-destroying properties. Nye, Zerfos, and Cornwell also showed a higher percentage of yeast-like fungi in gastric contents in the same conditions.

Goldman showed that the bacteria introduced with food and saliva multiply only temporarily on the inside of the undigested food masses. Arnold and Brody (3) described the "auto disinfecting" mechanism of the upper intestine as dependent upon the presence of acid buffered material. This reaction is insured in the normal healthy animal by normal gastric secretory function. However, when neutral or alkaline buffered material enters the duodenum the bactericidal power is lost. Prentiss concluded that hydrochloric acid exerts a strong inhibitory effect on the growth of ordinary bacteria which enter the gastro-intestinal tract. The other enzymes and bile secretions do not seem to have any antiseptic power. Butler stated that, after gastrectomy, there is a loss of the

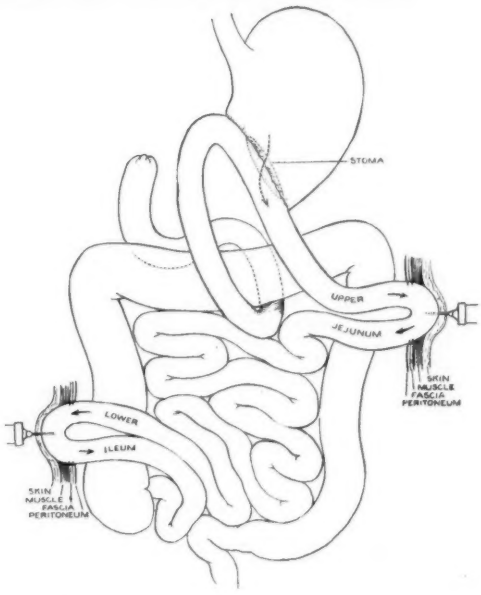

Fig. 1. Drawing of partial gastrectomy on dog. The method of fixation of the intestinal loops and the aspiration of the intestinal contents is shown.

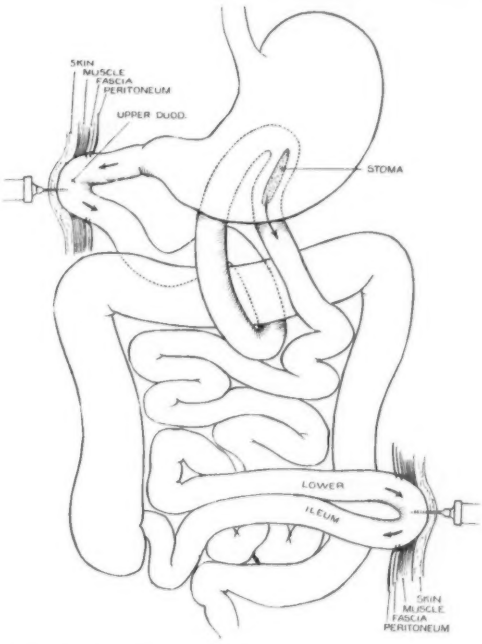

Fig. 2. Drawing showing gastro-enterostomy. The method of fixation of the intestinal loops and the aspiration of the intestinal contents is shown.

sterilization by the stomach and with the increase in the alkalinity the bacteria spread upward from the colon to the upper small intestine. In 22 cases of perforated gastric and duodenal ulcers, Lohr was unable to find colon organisms in the peritoneal exudate in the first stages.

These and many similar reports demonstrate several features of the interrelationship of the upper intestinal flora and gastric secretion. The gastric acidity has apparently two-fold action in the control of the intestinal flora of the upper small intestine. The bactericidal action on ingested food has been very conclusively proved and is of great importance. However, the feature of the acidity of the duodenal contents and its influence on the intestinal flora has been considered by only few workers from an experimental standpoint.

EXPERIMENTAL PROCEDURES

Four of the animals are considered in this report, as various experimental and laboratory factors preclude the use of the others operated upon. Two dogs were experimented with at the same time; one being subjected to a gastro-enterostomy and the other to a partial gastrectomy. In the first group, the intestinal flora was studied from both the upper and lower small intestine while in the second group material was obtained from the jejunum only.

The intestinal loops were established after the method described by Arnold and his co-workers. In the first group, having two loops, two pararectal incisions were made down to the peritoneum. When the peritoneal cavity was opened the appropriate part of the small intestine was grasped in forceps and withdrawn from the abdomen. About 5 centimeters was finally utilized for the loop. The peritoneum was sutured to the intestine along the mesenteric attachment so as not to interfere with the circulation or obstruct the lumen of the bowel. The deep fascia was then sutured near this peritoneal attachment and the skin closed over the loop, a sub-

TABLE I.—RESULTS IN DOGS 1 AND 2

INTESTINAL FLORA	Before operation	After operation
Dog 1—gastrectomy:		
Colony count (average) jejunal loop—per c.cm	8,500	78,000
Colony count (average) ileal loop—per c.cm	89,500	212,000
Dog 2—gastro-enterostomy:		
Colony count (average) duodenal loop—per c.cm	28,500	39,000
Colony count (average) ileal loop—per c.cm	141,000	240,000

GASTRIC ANALYSIS	Before operation Free Hcl.	Before operation Total acid	After operation Free Hcl.	After operation Total acid
Dog 1—gastrectomy:				
Fasting	15	25	0	35
First hour	10	73	0	55
Second hour	15	95	0	80
Dog 2—gastro-enterostomy:				
Fasting	10	35	20	45
First hour	14	82	10	83
Second hour	24	80	10	85

cuticular stitch being used. Collodion dressing was then applied. In this way the portion of intestine for study was anchored beneath the skin, and the contents were removed at any desired time by means of a large needle inserted through the skin into the bowel. In the dog which was to be subjected to a partial gastrectomy the two incisions were placed as follows:

The jejunum was brought through the upper left incision and the ileum through the lower right(Fig. 1). In the dog with the future gastro-enterostomy, the duodenal loop was withdrawn through the upper right incision and the ileum through the lower left (Fig. 2). In the second group of animals only one loop was prepared, in which the upper jejunum was brought through a right pararectal incision. The animals were given water for the first 24 hours and then they were gradually returned to the previous diets. Each animal was kept on a standard diet for several weeks before it was used for experimental work.

The bacterial flora was analyzed as follows: The skin over the artificial hernia was shaved and iodinized. A large bore hypodermic needle was plunged through the skin into the lumen of the bowel and the contents were withdrawn and put into sterile test tubes. The loops were aspirated usually one hour

TABLE II.—RESULTS IN DOGS 3 AND 4

INTESTINAL FLORA	Before operation	After operation
Dog 3—gastro-enterostomy:		
Colony count (average) jejunal loop—per c.cm	10,500	21,800
Dog 4—gastrectomy:		
Colony count (average) jejunal loop—per c.cm	22,000	110,600

GASTRIC ANALYSIS	Before operation Free Hcl.	Before operation Total acid	After operation Free Hcl.	After operation Total acid
Dog 3—gastro-enterostomy:				
Fasting	0	15	0	25
First hour	10	65	15	50
Second hour	25	90	20	83
Dog 4—gastrectomy:				
Fasting	0	20	0	15
First hour	25	80	0	45
Second hour	20	115	0	75

after feeding. The intestinal material was then plated in varying dilutions up to 1:100,000 on blood agar plates and analyzed. Endo plates, broth cultures, and fresh smears were made simultaneously. Colony counts were made after 48 hours' incubation at a temperature of 37 degrees C., and the various bacteria were identified from the different media. These bacterial studies were made at weekly intervals.

After this stationary period had been reached and the animals were in good general health, the second operative procedure was carried out. This consisted in performing a gastro-enterostomy in one dog of each group and a partial gastrectomy in the other. The technique followed has been described by the author in a previous paper. The bacterial flora was studied after the animals had recovered from the operations. The results of the normal and postoperative periods are included in Tables I and II. The gastric content was analyzed during the stages of the experimental work and the results are also included in the tables.

DISCUSSION

The jejunal loop showed a marked increase in the colony count after subtotal gastrectomy (Table I), whereas no similar findings were noted after gastro-enterostomy. Likewise, the qualitative analysis of the former showed an entirely new flora with fæcal organisms pre-

dominating. After a considerable period of time this had all the characteristics of the contents from the ileum loop. Changes were also seen in the ileum loop after the stomach operations, those being most marked after the subtotal gastrectomy. The gastric analyses demonstrated a condition of achlorhydria, as has been previously noted by the author (10), after the partial removal of the stomach in contradistinction to no material alteration after the gastro-enterostomy. The results obtained in dogs 3 and 4 (Table II), in which only a jejunal loop was utilized, were quite similar to those which were obtained in the previous animals.

The upper intestinal flora was definitely changed after partial gastrectomy. The explanation of this is probably dependent on several factors. The stomach after a subtotal gastrectomy still secretes free acid, although in smaller amounts, and food leaves the stomach in about half the normal time. These two facts in addition to the ease of influx of alkaline pancreatic juice, bile, and duodenal secretion into the stomach with its neutralization of the small amount of gastric secretion permits the bacteria-laden food to pass into the small intestine with very little alteration. The bacterial growth is further enhanced by encountering a marked alkaline medium in the jejunum. Later, the lower intestinal flora gradually spreads upward and finally the flora of the entire small intestine becomes practically homogeneous.

The intestinal flora after gastro-enterostomy did not show similar changes, as here the bactericidal action of the stomach was still active and the acidity of the upper small intestine was only slightly reduced.

CONCLUSIONS

1. The upper intestinal flora of dogs is markedly changed after subtotal gastrectomy and gradually assumes the fæcal character of the lower intestine.

2. Gastro-enterostomy does not materially alter the bacterial flora of the intestinal tract.

3. Alteration in intestinal flora after the partial removal of the stomach is probably due partly to the loss of the bactericidal activity of the stomach through the establishment of an achlorhydria, partly to the more rapid emptying time of the stomach, and, finally, the alkaline medium of the jejunum greatly predisposes to the further multiplication of its bacterial content.

4. A clinical deduction may be drawn in that, although partial gastrectomy seems to be the best operation in certain cases of ulceration of the stomach and the duodenum, a new factor is introduced with the fæcal change of the upper intestinal flora. The results of this alteration in the general body physiology will take many years to establish.

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ABERRANT BLOOD VESSELS AS A FACTOR IN LOWER URETERAL OBSTRUCTION

PRELIMINARY REPORT[1]

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OBSTRUCTION of the lower ureter by aberrant vessels or bands of fibrous tissue has evidently been deemed not sufficiently important to warrant special consideration by the surgeon, as evidenced by the manifest paucity of literature on the subject. In monographs and articles considering stricture of the lower ureter, many causative factors are assigned for this condition, among which, infections from either local or peripheral foci, traumatism, syphilis, cystitis cystica, etc., may be mentioned. Adventitious bands and vessels as etiological factors apparently have not been given consideration.

The following study has as its basis the operative findings in a case of ureteral calculus obstructed by an aberrant artery and band of fibrous tissue at the midpelvic portion of the ureter; the autopsy findings in a case with similar obstructive pathology in a male cadaver; together with observations made during a series of dissections to determine the relation between aberrant vessels and the ureter and between parietal vessels of the pelvis and the bladder.

On August 25, 1923, M. H., a male, 44 years of age, admitted to the service of Doctors McCarthy and Bandler, at the Post-Graduate Hospital, came under my care. He complained of pain in both loins and persistent vomiting. For 3 years prior to admission, this patient suffered sharp intermittent pain over the sacro-iliac and kidney regions at intervals of 5 to 6 months. The pain was colic-like, lasted 6 to 8 hours, and was more severe in the region of the left kidney. He voided twice at night, but there was no diurnal frequency. Both his past and family history bore no relation to his present condition.

The patient was a man of average height and weight, somewhat anæmic in appearance, his aspect suggesting the presence of impending uræmia. Examination of his head, neck, and chest showed no abnormality. The heart was found to be surgically competent, though the sounds were diminished in volume. The kidneys were not palpable. The liver was very much enlarged. There was marked tenderness on deep palpation in the right and left ureteral regions. The external genitalia were normal on inspection and palpation. The prostate, on bimanual rectal examination, was normal in size and contour with no fixation or areas of hardness or induration. Seminal vesicles were not palpable. The pulse showed slight increase in rapidity. Temperature and respirations were normal.

The urine was alkaline in reaction with a small amount of protein present. An occasional hyaline cast as well as two to three red and white blood cells were found in the high power field.

The blood picture showed: erythrocytes, 4,736,000; leucocytes 23,600; with a hæmoglobin of 81 per cent; differential count of 100 white cells; polynuclear neutrophiles 84 per cent; small lymphocytes 8 per cent; large lymphocytes 8 per cent; indicating moderate leucocytosis. Blood pressure and coagulation time were normal. Chemical examination of the blood made on August 27, 1923, was as follows: Uric acid 8.5 milligrams per 100 cubic centimeters; urea nitrogen, 63.5 milligrams; creatinine, 3.5 milligrams; sugar 0.176 per cent per 100 cubic centimeters; chlorides, 0.475 per cent. Subsequent chemical blood examination made on September 4, 2 days before operation, showed that no material change had taken place, the urea nitrogen being 61.9 milligrams per 100 cubic centimeters, and creatinine, 3.1 milligrams.

X-ray examination of the genito-urinary tract showed that the right kidney was of comparatively normal outline and dimensions; the left appeared to be considerably enlarged and lower than the right (Fig. 1). There was no evidence of calculus in the upper urinary tract, but two roughly triangular shadows were apparent in the lower. One was in the lower central right bladder region (Fig. 2) and the other just above the left ischial spine, suggesting the presence of calculi in the ureters.

On August 27, 1923, cystoscopic examination showed the bladder to be of normal capacity with the presence of a moderate degree of cystitis. The left ureteral orifice was normal in appearance; the right was surrounded by a zone of œdema, a factor indicating the presence of a calculus lodged at, or immediately above, the intramural portion of the ureter. An ureteral catheter could not be advanced up the right ureter more than a few centimeters. Indigo-carmine renal function test showed no dye from the left side and only a small amount from the right side. Dilatation of the ureters was attempted

[1] Read before the Section of Genito-Urinary Surgery, New York Academy of Medicine, April 18, 1928.

Fig. 1. Roentgenogram of kidney region showing enlarged left kidney.

Fig. 2. Roentgenogram of lower ureteral and bladder region showing calculus shadow in right lower ureter, which appears to be in the right lower bladder region; left, calculus shadow seen at the midpelvic portion of the ureter.

through the cystoscope, and following the manipulation, the patient had anuria for 24 hours, which gradually subsided. The chemical examination of the blood showed the urea nitrogen and creatinine to be 61.9 milligrams per 100 cubic centimeters and 3.1 milligrams per 100 cubic centimeters respectively. An X-ray and cystoscopic examination on the same day (September 4) showed no advance of the calculi.

The persistence of pain in this patient's left ureteral and kidney regions, with no apparent improvement in his general condition, was deemed sufficient to warrant an operation to prevent permanent impairment of the kidneys.

On September 6, 12 days after admission, I performed a ureterotomy, making a median suprapubic incision with an extraperitoneal approach, in a manner similar to that employed in operations on the bladder for neoplasm or diverticulum. This incision was used instead of the usual oblique or vertical abdominal exposure in order to give easy access to both ureters through a single wound. The bladder was mobilized on its anterior aspect and freed on the right side down to the vesicopelvic fold; the ureter was identified and a calculus found lodged slightly distal to the intramural portion of the ureter. The wall of the ureter was incised longitudinally, and through its outer intramural portion the calculus was removed. A single suture of catgut was inserted to close the ureteral incision loosely. Following this the bladder was freed in a similar manner on the left side, and a moderate size calculus was palpated within the lower ureter at its midpelvic portion. The ureter was bound down by a transversely running band of fibrous tissue, traversed by an artery, approximately 6 to 8 centimeters above the ureteral orifice, and was dilated above the band and the vessel. It was impossible to force the calculus through the constriction. The fibers were teased away, the vessel clamped in two places, cut, and ligated. The ureter, now freed, was incised longitudinally and the calculus was removed. The lumen of the lower portion of the ureter was dilated and the ureteral incision closed with a suture of plain catgut. The abdominal wound was closed in the usual manner, a prevesical drain inserted, and a cigarette drain, from each ureteral incision, brought out at the lower angle of the wound. Recovery was uneventful; the prevesical drain was removed at the end of 7 days, the wound healed by first intention, and the patient left the hospital 23 days after operation, fully recovered.

The finding of an aberrant vessel with a reinforcing band compressing the ureter at this site, 6 to 7 centimeters above the ureteral orifice, and causing obstruction to the passage of a calculus, was thought to be of sufficient interest to warrant further investigation.

Reference to the literature shows numerous articles on aberrant vessels of the kidney region and the upper ureter. These vessels

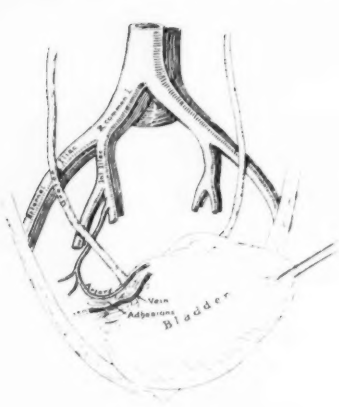

Fig. 3.

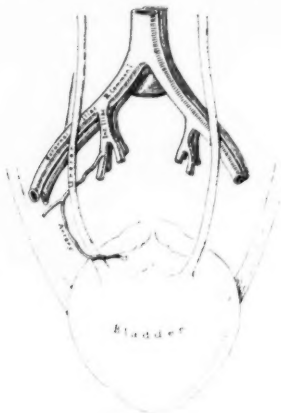

Fig. 4.

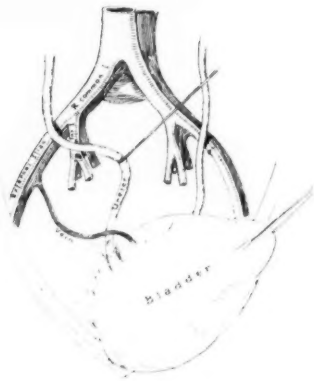

Fig. 5.

Fig. 3. Schematic drawing from a cadaver, showing the bladder retracted to the left and a band of fibrous tissue, artery, and vein crossing the ureter at right angles.

Fig. 4. The bladder has been pulled anteriorly, thus exposing the lower ureter, the seminal vesicles, etc., and showing the artery from the hypogastric encircling the ureter.

Fig. 5. The bladder retracted to the left side, thus showing a vein coming from the external iliac and looping about the ureter.

have been considered not only from an anatomical standpoint but as possible important causative factors in obstructive ureteral and renal pathology. Our knowledge along these lines has been greatly augmented by the work of Pitt, Pasteau, Ekehorn, as well as Mayo, Ruppert, Eisendrath, and others in this country. Writers differ as to the frequency of the occurrence of aberrant vessels at this site, the average being 20 to 25 per cent, some even going as far as Hellstroem,[1] who, in a very complete article states that the renal arteries show so many variations with respect to number, origin, and distribution that it is almost more common to observe a condition that is abnormal in some respect than a condition that is normal in all respects. In our own series of over two hundred dissections of males, 18 per cent showed definitely atypical renal vessels. In none of these, however, could obstruction to the ureter or kidney pelvis be demonstrated.

In renal surgery we anticipate the presence of aberrant vessels and, if present, clamp in two places before incising and ligating. The suggestion of Eisendrath still holds good: "During nephrectomy or even nephrotomy, the poles of the kidney should be carefully exposed. The mobilization of the kidney should be gradual, care being taken, at the lower and upper poles, never to tear or divide adhesions or strands of fibrous tissue before they have been inspected and also palpated (for a possible pulsation) to exclude the possibility of a supernumerary vessel."

After careful search, no reference has been found to vessels as a cause of obstruction of the lower ureter. If the anatomy of the region is considered—a small space crowded with mobile structures which have an elaborate blood supply—it is fair to assume that anomalous vessels should be present, in view of the fact that changes take place in these organs and vessels at and after birth, and that aberrant vessels should frequently be found in the upper ureter and kidney regions.

The following is a brief description of the course of the vessels and the ureter in the pelvis as described in the standard anatomical works. The external and internal iliac arteries and their companion veins—branches of the common iliac—normally take their origin in the vicinity of the sacro-iliac synchrondrosis on a level with the lumbosacral articulation. The external iliac passing along

[1] Ueber die Varranten der Nierengefaesse. Ztschr. f. urol. Chir., 1928, xxiv, 253.

the brim of the pelvis to the lower border of Poupart's ligament, where it becomes the femoral, is not relevant to our present study. The internal iliac, the hypogastric artery, a short wide vessel approximately one and one half inches long, descends into the pelvis minor and divides near the upper margin of the greater sacrosciatic notch into an anterior or visceral, and posterior or parietal group.

Sabotta[1] states that the internal iliac divides in a very inconstant manner. The anterior branch passes downward and forward and gives off the obturator, which passes to the obturator foramen and the umbilical branch. The latter passes forward to the posterolateral aspect of the bladder, is crossed by the ductus deferens, and gives off the superior, middle, and inferior vesical arteries, terminating in the obliterated hypogastric or lateral umbilical ligament. The inferior vesical artery is described in several anatomies as an independent branch from the anterior branch of the hypogastric artery. A branch to the vas (the deferential artery) may originate from any of the vesical arteries though it arises most frequently from the inferior or middle. Occasionally all the branches of the internal iliac artery arise, without previous separation of that vessel, into two portions (3.3 per cent).[2]

The ureter in its downward course crosses anteriorly to the external iliac at or near its origin and passes downward and inward along the front of the hypogastric artery. It then turns mesially below the ductus deferens in the male toward the base of the bladder.

A series of dissections of male cadavers served to show that these vessels show wide variations both in course and distribution. Among the first dissections, as illustrated in Figure 3, an aberrant artery and vein were found which crossed the ureter at right angles; accompanying them was a band of fibers which traversed the ureter 7 centimeters above the ureteral opening, being practically a replica of the condition found in the patient whose history is cited.

[1] Atlas and Textbook of Human Anatomy. Philadelphia: W. B. Saunders Co., 1907.

[2] Jastschinski. Die typischen Verzweigingsformen der Arteria hypogastric. Internat. Monatschr. f. Anat., 1891, viii. Quoted by Quain, Anatomy. vol. ii, pt. 2, 10th ed., p. 473.

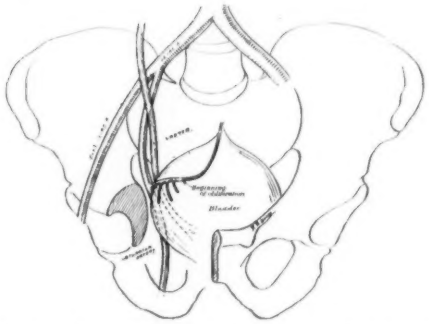

Fig. 6. Schematic drawing showing the vesical branches coming from the umbilical artery anterior to the ureter.

Another interesting anomaly (Fig. 4) was an atypical vessel, a branch of the obturator artery, which crossed the ureter to the anterior surface of the bladder without coming in contact with the ureter. Branches from the obturator artery to the bladder wall were found in four instances in our dissections up to the present time. While some of these are small as described in the textbooks, in several instances a large branch of the obturator was found which crossed to the side of the bladder, taking the place of the inferior vesical artery which was absent, and giving off a branch which extended backward, looped about the ureter, and terminated as the deferential artery. An extreme type was observed in a recent dissection in which there was no umbilical artery on either side, the vesical arteries—superior, middle, and inferior—being given off by the obturator artery of the corresponding side.

In another instance (Fig. 5) a vein from the external iliac looped itself about the lower ureter.

The hypogastric and its branch, the umbilical artery, vary greatly in length. The umbilical artery has been found to show marked variation both as to the site of its junction with the bladder wall and the extent to which it is in relation to it. At the crossing of the ureter and the vas the umbilical artery is found to be external to these structures. Depending on their point of origin from the umbilical artery, the vesical branches are found to course either external or internal to the ureter. Similarly the site of origin from

Fig. 7. The bladder is retracted to the left so that the vesical branches are seen radiating over the ureter to the bladder wall like the spokes of a wheel.

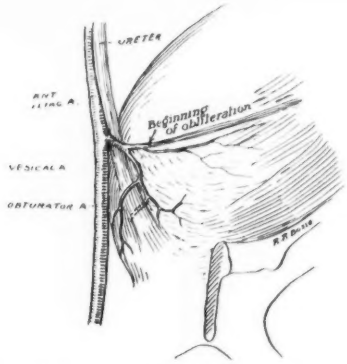

Fig. 8. Bladder retracted to the left thus exposing a branch of the vesical artery passing over the ureter and another branch encircling it in the opposite direction.

the umbilical artery determines their future relationship to the ureter. Thus a branch arising near the beginning of the umbilical artery would be apt to have a more intimate relationship to the ureter than one arising in the more distant portion of that vessel. This is schematically illustrated in Figure 6. Occasionally a branch extends backward to cross the ureter posteriorly. The origin and course of the hypogastric artery and its branches in their relation to the ureter have been found to be important factors in determining the possibility of ureteral compression.

In two instances as shown in Figure 7, the unobliterated part of the hypogastric artery, which was less than a centimeter in length, was found to break into a group of vesical arteries, radiating like the spokes of a wheel, crossing over the ureter, and on to the bladder. Each vessel as it crossed the ureter could be seen to be attached to it. Many types of variations as to the origin of the vesical arteries and their branches, as well as to their distribution, were found in different subjects and even in the same subject.

Another type (Fig. 8), of which several were found, shows one branch passing over the ureter externally while another branch encircles it in the opposite direction by passing beneath it. These last two types are illustrative of the potential sources of obstruction to a fair sized calculus.

To date, a summary of our dissections of twenty bodies shows that the hypogastric artery, taking its origin 10 to 11.5 centimeters above the ureteral opening, divides into an anterior and posterior branch. The former passes downward posteriorly to the ureter and divides 6 to 8 centimeters above the ureteral opening, the so-called "mid pelvic stricture area" of the ureter,[1] into an obturator and umbilical artery. From these vessels, as well as the parietal branches, two types of vascular anomalies have been observed. The first group by passing from the pelvis to the bladder wall may be a source of embarrassment in operations on this viscus. These are branches from the obturator artery or vein, a vein from the femoral vein, and a branch of the posterior hypogastric artery passing on to the bladder wall. The second comprises those vessels which through proximity to the course of the ureter may interfere with the passage of calculi as in the case reported. These, with or without reinforcing bands of fibrous tissue, may have to be reckoned with as a causative element in stricture of the pelvic ureter. The vesical arteries, taking origin from the umbilical artery, have been seen to cross the ureter in many instances and have been found to vary, not only as to site of origin, but also as to course and distribution. While these vessels are often of small

[1] Young. Practice of Urology, vol. i, p. 19. Philadelphia: W. B. Saunders. 1926.

caliber, some are of large size and have been palpated through the bladder wall in the cadaver in injected subjects.

The work thus far seems to point the way to a logical explanation of some of the obstructive lesions of the lower ureter. Hunner[1] finds that there is a frequent association of ureteral stricture and venous phleboliths in the immediate neighborhood. In discussing the location of the stricture, he finds the most frequent site to be within 6 centimeters of the bladder; and the next in frequency, at the bifurcation of the iliac vessels. He explains this by the location of glands along the iliac vessels and emphasizes the difference between these sites and the areas of congenital narrowings, i.e., the pelvic brim and the intramural portion of the bladder. Our studies, I believe, explain the fact that a calculus may, at times, "hang" for a considerable period of time at the midpelvic portion of the ureter —an area of the ureter which is normally of large caliber.

[1]Hunner. Bull. Johns Hopkins Hosp., 1918, xxix, 5.

SUMMARY

Obstruction of the lower or pelvic portion of the ureter can be produced by blood vessels which may be normal to the region but pursue an atypical course, or by adventitious structures foreign to the location through which they run.

The possibility of vessel obstruction should be considered and borne in mind both before and at the time of operation.

Treatment is operative in a large percentage of cases and is based on the usual case history and careful urological examination.

Importance of the subject warrants careful investigation and future anatomical and clinical research.

For their efficient aid in carrying out the dissections referred to in this presentation, I am indebted to, and wish to thank, Drs. Harold D. Berlowitz and S. E. Kramer; and for his courtesy and generous co-operation in permitting the use of the necessary anatomical material, I wish to thank Dr. Charles Norris.

THE VALUE OF LIVER IN THE TREATMENT OF ANÆMIA DUE TO HÆMORRHAGE[1]

WILLIAM P. MURPHY, M.D., AND JOHN H. POWERS, M.D., BOSTON

THE beneficial effect of the ingestion of large amounts of liver or an effective substitute in the treatment of pernicious anæmia as originally reported by Minot and Murphy (3, 4, 5) has been confirmed in numerous clinics. Excellent results have been reported with regularity. An adequate, well balanced diet containing liberal amounts of fresh vegetables, fruit, and red muscle meat forms a valuable adjunct to the administration of liver.

Whether or not such a combination of food substances will also influence favorably the production of hæmoglobin and red blood corpuscles in the various types of "secondary" anæmia which one encounters in man is a question which has given rise to much speculation. Because of the diversity of etiological factors which may contribute to the development of anæmia, it is obvious that this question can be answered only by studying critically the effect of such a diet in a series of cases in which one factor alone is involved.

Whipple and his associates (11) have described the beneficial effect of liver and of certain other substances on the formation of hæmoglobin in dogs made anæmic by controlled bleeding. Hart and his collaborators (1, 9) have demonstrated that a dose of 0.5 milligram of iron six times a week is ineffective in correcting a progressive anæmia in rats confined to a diet of cow's whole milk. They have shown, however, that an equal amount of iron fed as the ash, or acid extract of the ash, of dried lettuce, of yellow corn, or of beef liver is very potent in restoring the hæmoglobin to normal. The substances from beef liver are distinctly more valuable than either of the others mentioned. These authors have suggested that the small amount of copper contained in the potent ash or extract may enhance the utilization of iron by the body in the regeneration of hæmoglobin.

The object of the present study has been to observe the effect of liver together with a well balanced diet on the blood of patients with anæmia due to hæmorrhage.

CLINICAL MATERIAL AND METHODS OF STUDY

Seventeen surgical patients have been under observation. Eleven of these patients received 180–240 grams of prepared beef or calves' liver daily, at least 300 grams of green vegetables, an equal amount of fruit, and about 100 grams of red muscle meat. The remaining 6 patients received in addition large doses of iron in the form of Blaud's pill (0.9–1.8 grams) or reduced iron (4 grams) daily. As a control to the results obtained in these 17 cases, a record has been made of the changes in the blood of 7 essentially comparable patients who received no liver or iron. These patients were given the regular hospital diet which contained the usual amount of meat and 150 grams of green vegetables daily.

After admission to the hospital each patient remained in bed during the first 2 weeks of observation. Dietary treatment was not instituted until all bleeding had ceased. Except in cases of emergency requiring immediate operative intervention, surgical treatment was deferred until after improvement had been observed under the new dietary regimen. The age of each patient, the duration of the hæmorrhage, the diagnosis, and the surgical treatment are recorded in Table I.[2]

The patients were observed daily; at frequent intervals determinations were made of the hæmoglobin percentage, the red blood corpuscle count, the blood volume, and the icteric index. The percentage of hæmoglobin was determined in most instances by the method of Sahli as modified by Osgood and Haskins (8). The red blood corpuscle counts were made on venous blood with standardized pipettes and counting chambers. Determinations of the

[2] We are indebted to Dr. John Homans for the privilege of following Case S-27170 under his care in the private ward of the Peter Bent Brigham Hospital, and to Dr. William P. Graves for the privilege of following Case "Private" under his care at the Parkway Hospital.

[1] Read before the Clinical Congress of the American College of Surgeons, Boston, Massachusetts, October 11, 1928. From the Medical and Surgical Clinics of the Peter Bent Brigham Hospital, Boston, Massachusetts. This study was aided by a grant from the Proctor Fund of the Harvard Medical School for the study of chronic diseases.

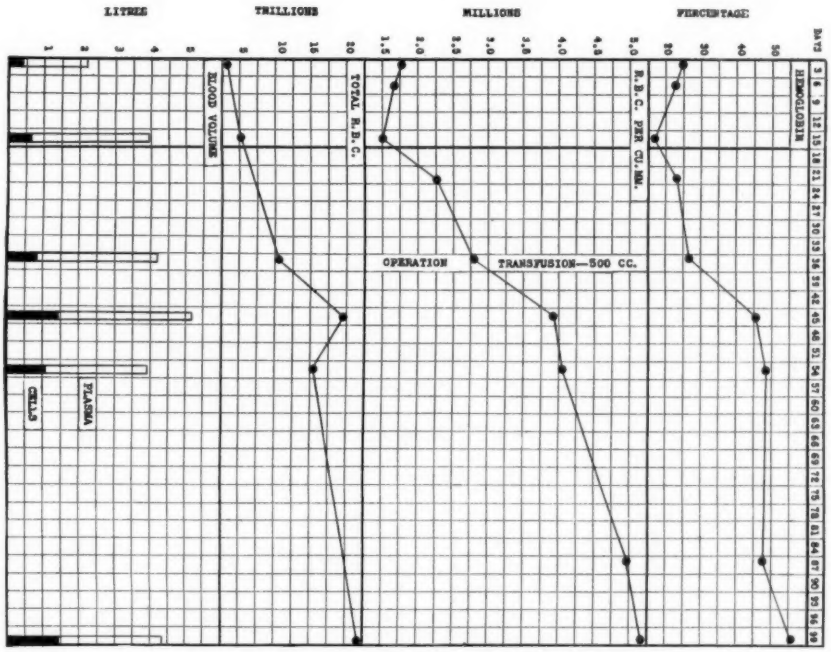

Fig. 1. A graphic representation of the effect of liver, a well balanced diet, and a transfusion of blood on the hæmoglobin, red blood corpuscle count per cubic millimeter, total number of red blood corpuscles,[1] and blood volume in a case of anæmia due to chronic hæmorrhage (S-29273). The vertical, heavy, black line shows where the dietary treatment was started.

blood volume were carried out according to the method suggested by Keith, Rowntree, and Geraghty (2), slightly modified as previously described by Murphy, Monroe and Fitz (7). The icteric index was estimated by the method previously suggested by one of us (6).

HÆMOGLOBIN AND RED BLOOD CORPUSCLES

The figures recorded in Table II show the course of the hæmoglobin and red blood corpuscles in the 11 patients treated with liver and the diet already described. The anæmia in 10 of these cases was the result of chronic hæmorrhage, varying in duration from 1 month to 8 years. The results in four representative cases (S-29273, S-28138, S-28107, S-28029) may be seen in graphic form in the first four figures. In one case (S-28182) the anæmia was due to acute hæmorrhage. The result in this case is shown in Figure 5. Changes in the blood volume and in the total number of red blood corpuscles, which are typical of the entire group, are recorded in these figures and need no further comment. The rate and degree of rise in the red blood corpuscle counts are comparable to those recorded in pernicious anæmia under similar treatment (3, 4, 7). In some instances, however, the increase in hæmoglobin lagged slightly behind the rise in red blood corpuscles. The color index remained below the usual normal level throughout.

The data obtained from the six patients to whom iron was administered in addition to the diet of liver, green vegetables, and fresh fruit are presented in Table III.

The records of the 7 control cases are summarized in Table IV. These patients were given no special treatment and received only the customary hospital diet. Two patients

[1] The total number of red blood corpuscles (in trillions) is the product of the number per cubic millimeter and the blood volume in cubic millimeters.

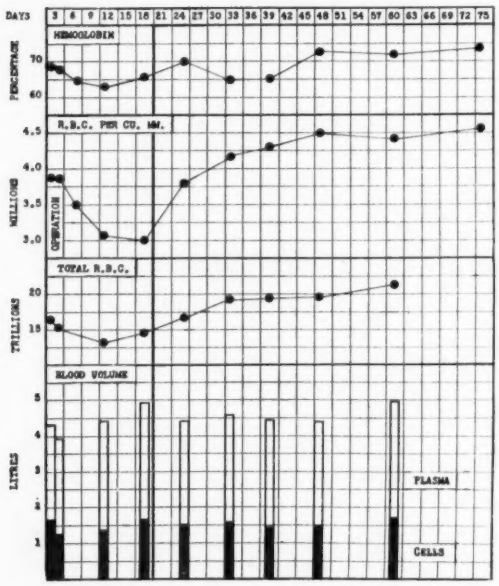

Fig. 2. A graphic representation of the effect of liver and a well balanced diet on the blood of a patient with anæmia due to chronic hæmorrhage (Case S-28138). During the interval at the left of the heavy black line the patient received only the regular hospital diet.

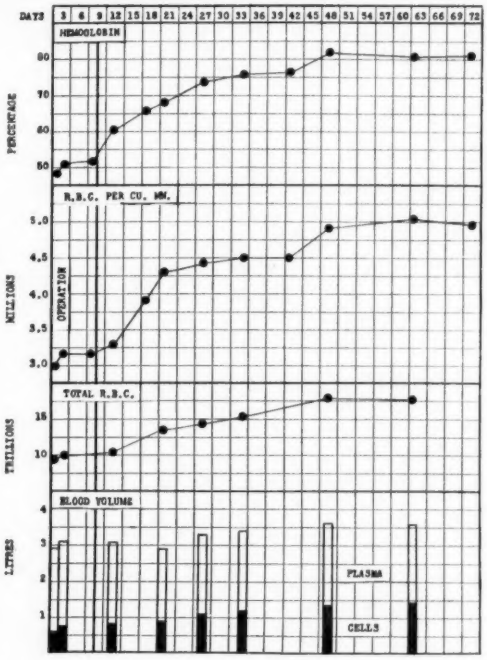

Fig. 3. A graphic representation of the value of liver and a well balanced diet on the blood of a patient with anæmia resulting from chronic hæmorrhage (Case S-28107). The immediate effect of dietary treatment is striking.

(S-29273, S-28138) included in this group, however, later received liver, and their subsequent course is shown in Table II and in Figures 1 and 2. The anæmia in the cases presented in Tables III and IV was the result of chronic hæmorrhage in each instance with the exception of cases S-29085 and S-26856 in which it was due to acute hæmorrhage. Both of these cases appear in the control group and should give this group an advantage.

A comparison of the changes which occurred in the blood as shown in these tables is of considerable interest. Unfortunately, it was impossible to record cases in the untreated control group which had been followed for longer than 2 weeks. A glance at the columns recording the hæmoglobin and red blood corpuscles in the three tables during a 2 weeks' period, however, will reveal a striking contrast between the definite increases noted in Tables II and III and the very slight increases recorded in Table IV. Fourteen, or 82.3 per cent, of the 17 patients whose figures are recorded in Tables II and III showed a definite increase in the percentage of hæmoglobin. Sixteen patients, or 94.1 per cent, showed an increase in red blood corpuscles. Four, or 57.1 per cent, of the 7 patients in the control group, Table IV, showed an increase in hæmoglobin and only 3, or 42.8 per cent, showed any increase in red blood corpuscles. Eleven, or 64.7 per cent, of the patients treated with liver or liver and iron had an increase of 10 per cent or more in hæmoglobin and 14, or 82.3 per cent, showed an increase of 500,000 or more red blood corpuscles per cubic millimeter during the first 2 weeks after dietary treatment was instituted. In the same interval of time only 3, or 42.8 per cent, of the control patients showed a rise of 10 per cent in hæmoglobin and only 2, or 28.5 per cent, had an increase of 500,000 red blood corpuscles per cubic millimeter. Although it is not possible to compare the groups at the end of one month of treatment, it is of interest to note the striking increase which occurred both

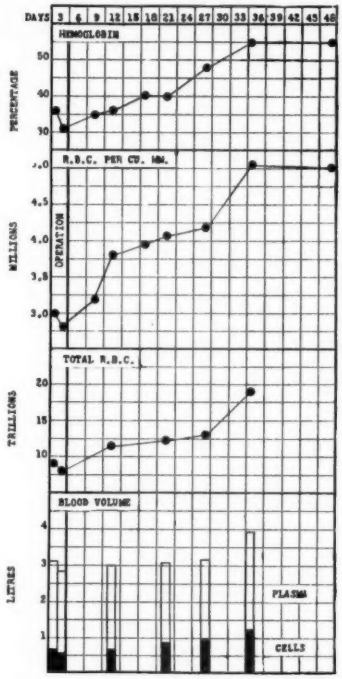

Fig. 4. Case S-28029. Anæmia due to chronic hæmorrhage. The regeneration of hæmoglobin was less prompt than the increase in red blood corpuscles. The patient received liver and the special diet but no iron.

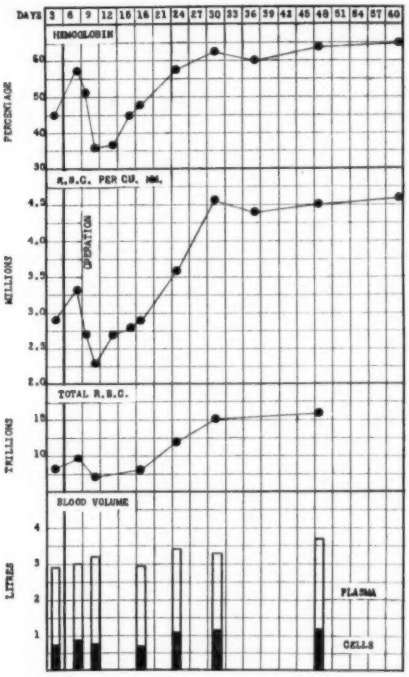

Fig. 5. Case S-28182. Anæmia due to acute hæmorrhage. The patient lost 500 cubic centimeters of blood during the operation. Regeneration of both hæmoglobin and red blood corpuscles was very rapid.

in percentage of hæmoglobin and in red blood corpuscles during such a short period of time. Those patients who were followed for 2 and 4 months continued to show a very gratifying improvement with the exception of two patients (S-29320, S-29570) whose red blood corpuscle counts became normal at the end of 4 months but whose percentage of hæmoglobin remained persistently low. Clinical improvement was also less striking in these two cases.

The averages for each group, shown at the bottom of the tables, are quite convincing evidence of the value of liver together with a well balanced diet in the treatment of this particular type of anæmia. During the first 2 weeks the total average increase in the percentage of hæmoglobin and in the red blood corpuscle count of the patients receiving liver was respectively 8.6 per cent and 1,000,000 cells per cubic millimeter. In the group treated with liver and iron, the hæmoglobin increased 13.8 per cent and the red blood corpuscles made a total average gain of 600,000 per cubic millimeter. In the untreated group the average increase in hæmoglobin was only 3 per cent; the red blood corpuscles decreased 100,000 per cubic millimeter. At the end of one month the patients who received liver had gained an average of 19.2 per cent in hæmoglobin and 1,700,000 red blood corpuscles per cubic millimeter. Those treated with liver and iron had gained an average of 26.2 per cent in hæmoglobin and 1,500,000 red blood corpuscles per cubic millimeter.

The cases in the three groups are essentially comparable in all respects. The average initial level of the hæmoglobin and red blood corpuscles was lower in the group treated with liver than in the other two groups; the average in the control group was slightly higher than in

TABLE I.—SUMMARY OF THE ESSENTIAL FACTS CONCERNING EACH OF THE SEVENTEEN PATIENTS TREATED WITH LIVER OR LIVER AND IRON

Surg. No.	Age	Duration of Hæmorrhage	Diagnosis	Operation
29273	47	4 months intermittent 1 month constant	Fibromyomata of uterus	Supravaginal hysterectomy. Salpingo-oophorectomy.
29320	51	1 year intermittent 2 weeks constant	Fibromyomata of uterus	Trachelorrhaphy; dilatation and curettage. Radium.
28138	27	1 year intermittent 2 months profuse	Hyperplasia of endometrium	Dilatation and curettage.
27989	46	2 years profuse	Fibromyomata of uterus	None.
29094	64	2 years moderate	Adenocarcinoma of rectum	Excision of carcinoma.
28182	24	2 days constant	Abortion, incomplete	Dilatation and curettage.
28107	27	1 month intermittent	Pregnancy, extra-uterine	Salpingectomy.
28037	37	Many years intermittent	Menorrhagia	None.
28029	20	2¼ months moderate	Hyperplasia of endometrium	Dilatation and curettage.
29149	51	8 years intermittent	Hæmorrhoids	Hæmorrhoidectomy.
26496	29	Many years moderate	Endometritis chronic	Dilatation and curettage.
30067	47	Several years intermittent	Epistaxis, hæmorrhoids	Hæmorrhoidectomy.
29570	37	Many years intermittent, 3 weeks profuse	Fibromyomata of uterus	Dilatation and curettage; radium.
Private	32	Several years intermittent	Endometritis menorrhagia	Dilatation and curettage.
27170	40	4 years intermittent	Fibromyomata of uterus	Supravaginal hysterectomy; salpingectomy.
27590	33	7 years intermittent	Menorrhagia	None.
29066	43	7 months intermittent	Fibromyomata of uterus	Supravaginal hysterectomy; salpingo-oophorectomy.
19637	36	2 years moderate	Fibromyomata of uterus	Supravaginal hysterectomy; salpingectomy.
29085	30	17 days moderate	Pregnancy, extra-uterine	Salpingo-oophorectomy.
14046	49	3 months moderate	Menorrhagia	None.
26856	33	3 weeks moderate	Pregnancy, extra-uterine	Dilatation and curettage; salpingo-oophorectomy.
22349	48	8 years slight	Hyperplasia of endometrium	Supravaginal hysterectomy; salpingo-oophorectomy.

the other two. This perhaps suggests that a smaller increase might be expected in the control patients than in those treated with liver or with liver and iron. However, the contrast is greater than one would expect, for there was actually very little gain in any case of the control series. Whereas the patients treated with liver, with or without iron, had made an essentially comparable gain in red blood corpuscles at the end of 2 weeks and 1 month, those treated with liver and iron had a distinctly higher average gain in percentage of hæmoglobin at the end of both periods. These observations suggest that anæmia resulting from chronic hæmorrhage may be treated satisfactorily by the administration of liver and that the production of hæmoglobin may be hastened by the addition of large doses of iron. An increase in red blood corpuscles may not be accompanied by a rise in hæmoglobin, and vice versa. Treatment must be instituted which will stimulate the regeneration of both elements if the best results are to be expected.

BLOOD VOLUME AND ICTERIC INDEX

Determinations of the blood volume were carried out at frequent intervals in the 11 patients treated with liver and serve to confirm the increase shown by the red blood corpuscle counts. The changes in total blood volume were, in most instances, relatively small and very largely proportional to the increase in corpuscle volume. Representative determinations are shown in the accompanying figures. Figure 1 shows data concerning an interesting change in blood volume which followed a transfusion of blood given on the twentieth day after the dietary regimen was started. On the ninth day after the transfusion both the corpuscle volume and total blood volume were definitely increased over that recorded just prior to transfusion, but by the eighteenth day both had fallen considerably. These changes are reflected by comparable alterations in the percentage of hæmoglobin and red blood corpuscle count. The ultimate result, however, appears to be very similar to that obtained in the other cases.

Repeated determinations of the icteric index were made in 12 cases. In 9 of these the reading was below the average normal index.

TABLE II.—THE EFFECT OF LIVER AND A WELL BALANCED DIET ON THE FORMATION OF HÆMOGLOBIN AND RED BLOOD CORPUSCLES IN ELEVEN CASES OF ANÆMIA DUE TO HÆMORRHAGE

Surg. No.	Admission		Two weeks				One month				Two months				Four months			
	Hæmoglobin in percentage	R.B.C. in millions	Hæmoglobin	R.B.C.	Increase in hæmoglobin	Increase in R.B.C.	Hæmoglobin	R.B.C.	Increase in hæmoglobin	Increase in R.B.C.	Hæmoglobin	R.B.C.	Increase in hæmoglobin	Increase in R.B.C.	Hæmoglobin	R.B.C.	Increase in hæmoglobin	Increase in R.B.C.
29273	17	1.5	27	2.8	10	1.3	46	3.9	29	2.4	48	5.0	31	3.5	73	5.5	56	4.0
29320	16	2.2	15	1.9	−1	−0.3	19	2.35	3	0.15	24	2.3	8	0.1	51	4.5	35	2.3
28138	66	3.0	65	4.2	−1	1.2	73	4.5	7	1.5	74	4.6	8	1.6				
27989	35	1.7	23	2.7	−12	1.0	34	3.5	−1	1.8	50	3.4	15	1.7				
29094	33	3.4	40	4.6	7	1.2	54	5.0	21	1.6	80	5.4	47	2.0				
28182	45	2.9	58	3.6	13	0.7	60	4.4	15	1.5	65	4.6	20	1.7				
28107	52	3.2	74	4.4	22	1.2	76	4.5	24	1.3	80	4.9	28	1.7				
28639	60	2.8	75	4.0	15	1.2	80	4.5	20	1.7								
28029	31	2.8	40	4.0	9	1.2	55	5.1	24	2.3								
29149	32	3.1	50	4.5	18	1.4	71	4.7	39	1.6								
26496	40	1.9	55	3.4	15	1.5	70	4.1	30	2.2								
Average	38.8	2.6	47.4	3.6	8.6	1.0	58	4.2	19.2	1.6	60	4.3	22.7	1.8				

There was no constant increase in the figure as the blood approached normal. In two cases (S-29094 and S-29085) in which the red blood cells and hæmoglobin were only slightly reduced the icteric index was normal. In one case (S-28017) the initial reading was slightly above normal but the color of the serum fell to below normal during a period of about 10 days. The anæmia in this case was largely the result of a ruptured tubal pregnancy with an initial count of 3,200,000 red blood corpuscles per cubic millimeter.

DISCUSSION

It is probable that liver contains many substances valuable to the metabolic processes of the body which are not contained in the liver extract effective for pernicious anæmia. One should not conclude that the results reported here concerning liver would hold true for simi-

TABLE III.—THE EFFECT OF LIVER, LARGE DOSES OF IRON, AND A WELL BALANCED DIET ON THE REGENERATION OF HÆMOGLOBIN AND RED BLOOD CORPUSCLES IN SIX CASES OF ANÆMIA DUE TO HÆMORRHAGE

Surg. No.	Admission		Two weeks				One month				Two months				Four months			
	Hæmoglobin in percentage	R.B.C. in millions	Hæmoglobin	R.B.C.	Increase in hæmoglobin	Increase in R.B.C.	Hæmoglobin	R.B.C.	Increase in hæmoglobin	Increase in R.B.C.	Hæmoglobin	R.B.C.	Increase in hæmoglobin	Increase in R.B.C.	Hæmoglobin	R.B.C.	Increase in hæmoglobin	Increase in R.B.C.
30667	33	2.2	46	2.4	13	0.2	68	3.1	35	0.9	83	4.1	50	1.9				
29570	30	3.2	36	3.6	6	0.4	55	3.4	25	0.2					55	4.8	25	1.6
Private	50	2.3	65	3.2	15	0.9	75	5.0	25	2.7					90	5.1	40	2.8
27170	45	3.0	55	4.2	10	1.2	65	5.1	20	2.1								
27590	35	3.4	57	4.0	22	0.6												
29066	44	3.9	61	4.5	17	0.6												
Average	39.5	3.0	53.3	3.6	13.8	0.6	65.7	4.1	26.2	1.5								

TABLE IV.—THE RATE OF FORMATION OF HÆMOGLOBIN AND RED BLOOD CORPUSCLES IN SEVEN UNTREATED CASES OF ANÆMIA DUE TO HÆMORRHAGE

Surg. No.	Admission		Two weeks				One month			
	Hæmoglobin in percentage	R.B.C. in millions	Hæmoglobin	R.B.C.	Increase in hæmoglobin	Increase in R.B.C.	Hæmoglobin	R.B.C.	Increase in hæmoglobin	Increase in R.B.C.
19637	55	2.9	65	3.5	10	0.6	65	4.2	10	1.6
29085	71	4.3	68	3.6	−3	−0.7	73	4.3	2	0
28138	69	3.9	66	3.0	−3	−0.9				
29273	25	1.8	17	1.5	−8	−0.3				
14046	35	3.1	45	3.5	10	0.4				
20856	55	2.5	65	3.2	10	0.7				
22349	50	3.9	55	3.5	5	−0.4				
Average	51.4	3.2	54.4	3.1	3	−0.1				

lar cases treated with extract. The value of liver extract which is effective for pernicious anæmia is yet to be determined in cases of anæmia due to chronic hæmorrhage. Observations made by Whipple on dogs rendered anæmic by controlled bleeding suggest that liver extract Number 343[1] (11) has a different effect on these animals than comparable amounts of whole liver. His observations suggest that a small amount of whole liver given with the extract is more effective in enhancing blood regeneration than equivalent amounts of the extract alone.

SUMMARY AND CONCLUSION

Observations are recorded showing the rate of formation of hæmoglobin and red blood corpuscles in a series of 24 cases of anæmia due to loss of blood. Hæmorrhage in all except three cases was of a chronic nature.

Seventeen patients were treated with large amounts of beef or calves' liver together with a diet containing green vegetables, fruit, and red muscle meat. Six of these patients received in addition large doses of iron. Seven control patients received neither iron nor a special diet. These seven patients showed very little change in the concentration of either hæmoglobin or red blood corpuscles during a period of 2 weeks. The 17 patients treated with liver or liver and iron showed a definite increase in both hæmoglobin and red blood corpuscles in all except three cases. The patients treated with liver and iron had a greater increase in hæmoglobin than did those treated with liver. Those patients receiving liver who were followed from 1 to 4 months continued to show improvement comparable to that observed during the first 2 weeks, with the exception of two patients, whose percentage of hæmoglobin remained persistently low.

From these observations it appears justifiable to conclude that liver together with such a dietary regimen as that described stimulates the formation of hæmoglobin and red blood corpuscles in patients with anæmia due to chronic hæmorrhage. The formation of hæmoglobin is still further increased by the addition of large amounts of iron to this diet.

[1] The product tested was that manufactured by Eli Lilly and Company and supplied to Dr. Whipple through the courtesy of the Harvard Committee on Pernicious Anemia.

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CLINICAL SURGERY

FROM THE SURGICAL CLINIC OF PROFESSOR R. LERICHE, STRASBOURG

TECHNIQUE OF LEFT EPINEPHRECTOMY

E. STULZ, M.D., AND P. STRICKER, M.D., STRASBOURG, FRANCE

SURGERY of the thyroid gland, which was the starting point of endocrinological surgery, which 50 years ago boasted no fixed rules, and which was considered highly dangerous, has rapidly added to our knowledge of thyroid diseases. We may, therefore, assume that the surgery of the adrenal system may also elucidate pathological problems of the first importance that are yet but little known.

The fact that the adrenals are not easily accessible should not be, at the present state of surgical development, a stumbling block to the surgeon. That there are two adrenals is most advantageous, for although excision of one gland results in a marked reduction of adrenal tissue, it does not endanger life.

Besides extirpation of an adrenal for new-growth, several surgeons have undertaken epinephrectomies in order to cure epilepsy. Delbet, following an idea of Vaquez, did the operation in order to influence arterial hypertension. Von Oppel was the first to propose epinephrectomy in cases of spontaneous gangrene of the extremities. Since 1925, Professor Leriche (2, 3, 4) has studied the influence of left epinephrectomy in thromboangiitis obliterans (Buerger's disease) and in different vascular syndromes (Raynaud's disease, permanent cyanosis).

We believe that the time has come to publish the particulars of the technique applied in Professor Leriche's clinic and will, therefore, endeavor to give a résumé of the technique employed in the 13 operations witnessed by us and of the detailed anatomical studies on 4 amphitheater subjects.

The left adrenal is more easily extirpated than the right one, since the latter is situated in immediate proximity to the vena cava and is overhung by the liver. There are several ways by which to reach the left adrenal. Some authors, for instance Bruening and von Oppel, have advised the transperitoneal route, but this technique has all the drawbacks of any laparotomy on deep organs. Furthermore, it would not be very logical to follow this route in an operation on a gland which is not enlarged and which, therefore, does not protrude into the peritoneal cavity. The transperitoneal method should be followed only in cases of voluminous tumors of the adrenals.

We must further keep in mind that the usual incisions for renal approach are of little or no use, since they do not sufficiently expose the upper part of the kidney and the adrenal. On the other hand, approach to the gland through the back is not to be thought of, since such an approach would involve the risk of penetrating the pleural cavity. Logically the adrenal must be approached through a lateral extraperitoneal incision, which must be higher up than that used for renal operations and yet sufficiently low to avoid the pleural risk.

TECHNIQUE OF OPERATION

The patient is anæsthetized and placed, as for a left nephrectomy, on a lumbar support of the Pillet type, which can be raised at will. The right leg is kept flexed, the left stretched; the plane supporting the lower limbs is inclined, so that the costo-iliac space is widened as much as possible.

The surgeon stands behind the patient; his first assistant stands opposite him and on his left, that is to say toward the patient's feet; the second assistant stands opposite the operator and on his right but nearer the patient's head.

A lateral incision is used. The incision is from 12 to 15 centimeters (exceptionally 20 centimeters) long (Fig. 1), commences one or two fingers' width from the outer border of the left rectus abdominis, slightly above or at the level of the umbilicus; runs toward the upper margin of the twelfth rib, strikes it under an acute angle; crosses the rib; and ends near the external border of the erector spinæ muscles. The incision, therefore, divides the subcutaneous cellular tissue and the muscular masses of the obliquus externus, obliquus internus, and latissimus dorsi.

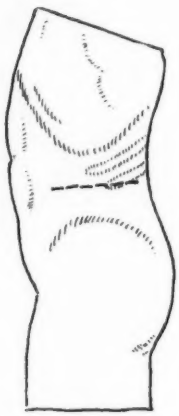

Fig. 1. Showing the line of incision.

The twelfth rib is resected for a length of from 5 to 8 centimeters. The lower part of the serratus posterior inferior and the fascia of the transversus abdominis are incised. In the anterior half of the incision there appears the subperitoneal fat; in the posterior half of the incision there appears the kidney pocket (Fig. 2). The whole mass is then separated from the posterior muscular layer.

The right hand is then introduced into the wound and gropes for the kidney, which is reached by its lateral border and anterior surface. When the kidney has been identified, the fatty capsule is opened by an incision of the fascia of Zuckerkandl near the inner border of the upper pole of the kidney and is then freed from the perirenal fat. With a big retractor the kidney is pushed downward and forward in the direction of the pubis, so as to facilitate the exposure of the subphrenic space. This manipulation at the same time drags down the adrenal, which is still wrapped in its fat, by means of the vascular pedicles that branch from the renal vessels.

The gland is then searched for in the epirenal fat and its base, which faces downward, backward, and outward, is usually discovered first (Fig. 3). The adrenal tissue is recognized by its yellow tint and is easily differentiated from fat. Care must be taken not to put a clamp or even a sponge-holding forceps on this most friable glandular tissue. Instead, the gland should be freed by blunt dissection with a dissector. After the dissection has been carried out for a certain length of time, the greater part of the base of a segment of the anterior surface of the organ are seen. Its upper margin, where the upper vascular pedicle (from the arteria phrenica inferior) reaches the gland, is also noted. Two ligatures are then carried around this pedicle and tied. The pedicle is divided between the ligatures. The part of the ligature nearest the gland is kept long, and traction on it permits the progressive freeing of the posterior surface, the anterior surface, and the inner border of the organ, from which numerous nerve threads run toward the left ganglion semilunare. These fine nerves are often cut or torn during the freeing of the inner border.

In order to obtain a good view during the freeing of the anterior surface and the inner border of the gland, one must displace the retractor, which until now has been kept on the upper pole of the kidney, its posterior face pulling the organ toward the pubis. The retractor is next put on the upper pole and the anterior part so as to pull the organ downward and backward. During the first step of the operation, the kidney pivots on its longitudinal axis and thus shows its external border. Now it is pushed straight downward toward the anterior superior iliac spine. Thismanipulation, combined with slight traction on the ligature, allows the operator to see the anterior surface of the adrenal. After the fat has been bluntly dissected away from this face, the vena suprarenalis is seen entering the gland and its hilus situated on the anterior face near the inner border (Figs. 4 and 5). The vein is cut between two ligatures. The arteria capsularis inferior runs parallel to the vein and can be secured by the same ligature.

Since the gland is now almost totally free, it is pulled toward the operator by the long ligature; a needle is run through its lower and inner part and a massive ligature tied. The gland is sectioned above this ligature, the knife being directed toward the kidney. A part of glandular tissue is left behind because of the possibility that the right adrenal may be absent or difficult deficient (Fig. 6). The total weight of the adrenal is about 4 grams, hence there is left from ½ to 1 gram of glandular tissue.

After a thorough revision of the wound and accurate control of hæmostasis, the wound is closed by sutures, as a rule without drainage. The closure is completed in four layers, the first of which closes the incision of Zuckerkandl's fascia. The dislocated kidney regains its normal position without any special measure of fixation. Then follows the suture of muscles which is done in two layers, the lumbar support having been first taken away. The skin is sutured in the usual manner.

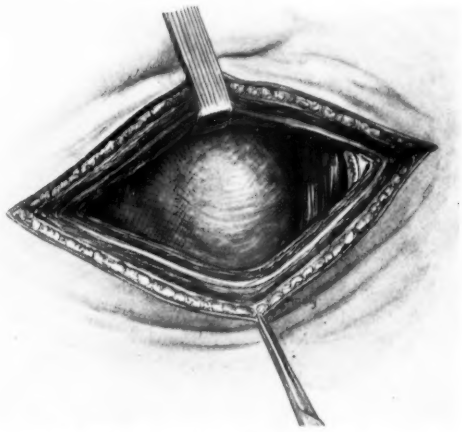

Fig. 2. Exposure of the kidney in its pocket.

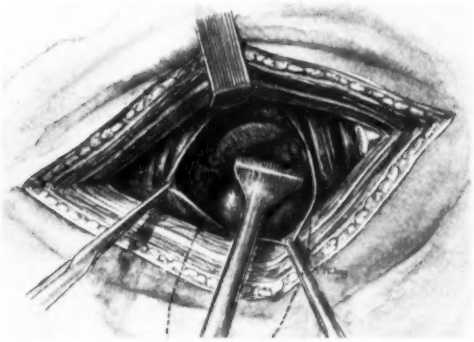

Fig. 3. The fatty capsule has been opened high up. The kidney is pushed downward and forward so that the base of the adrenal is visible.

DIFFICULTIES ENCOUNTERED

The technique described cannot always be followed in every particular. In most cases it is possible to remove the adrenal in one intact piece, but sometimes, especially in very obese patients, the depth of the wound and the friability of the gland make fragmentation necessary. The adrenal does not always have a fixed position with relation to the kidney and the neighboring organs so one must not expect to find it at once. As a rule its position is adrenal, but we must bear in mind that it does not always closely follow the kidney when this organ is pulled downward. If strong adhesions are present, it may be found very high up under the cupola of the diaphragm, and its upper margin may be so far from the incision as to make freeing difficult. In other cases the adrenal may be found stretched along the posterior surface of the kidney, in the immediate neighborhood of the aorta. This position may be an indication for the liberation of the anterior face first.

As to the vascular pedicles, it is not always possible to see all of them or to secure them individually. It must be kept in mind that they often are quite thin and reach the gland after having ramified. The pedicle that can be ligated in most cases is the hilar one which is the most voluminous. If the vein lies too deep down to be ligated, there is no harm in leaving it, as the venous hæmorrhage usually stops of its own accord.

When the adrenal is found in a low position, it may be necessary to leave the hilar part in its place and to insure hæmostasis beneath it by encircling it with catgut. Section is done above the ligature.

While seeking for the gland, one may observe a layer of brownish fat of a shade very much like that of the adrenal. This color has no pathological significance, the fat being histologically constituted of very small and quite sound fat cells.

In the first stages of the operation, it may sometimes be difficult to identify the upper pole of the kidney, especially in cases of ptosis. In this eventuality the spleen takes the kidney's place and can be seen through the pellucid peritoneum. Care must be taken not to mistake the spleen for the kidney and incise the peritoneum so as to search lower down and behind. It is not likely that the cauda pancreatis will be mistaken for the adrenal, since the pancreas has a grayish color and is much harder than the adrenal.

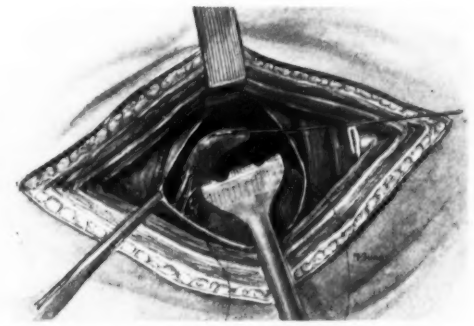

Fig. 4. The retractor pulls the kidney downward and backward. The anterior surface of the adrenal with the vein is freed.

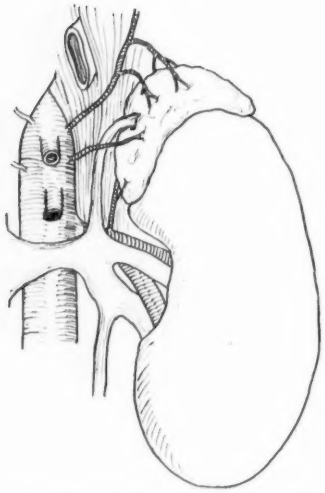

Fig. 5. Schema of the vascular pedicles of the adrenal.

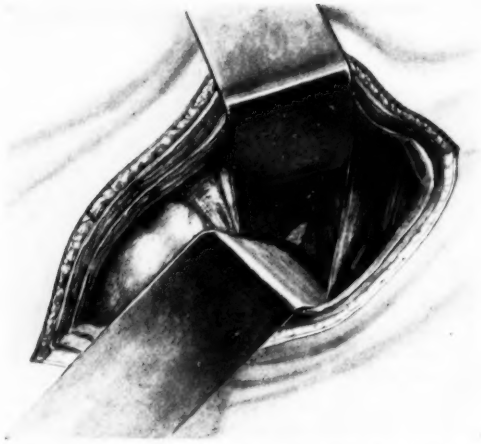

Fig. 6. After operation the inferior pole of the adrenal remains in place.

DANGERS TO BE AVOIDED

In 13 operations which have been performed the pleura has never been injured. Only once during operation on a cadaver did this mishap occur, because the incision was made much too high and too far posterior—between the eleventh and twelfth ribs. The peritoneum was opened once but without any serious result. This accident does not occur when care is taken to split the fatty capsule of the kidney far behind.

The larger vessels have never been touched, but one must beware of the aorta and especially the renal artery. Blunt dissection will prevent any accident.

POSTOPERATIVE CARE

As a rule the postoperative course is normal. The patients are practically apyretic. They never suffer from shock and recovery is rapid. In 25 per cent of the cases we were obliged to leave a gauze wick in place, but were able to remove it on the fifth day. During the first days following the operation there may be some slight meteorism which is easily relieved by hypophyseal extracts. Patients may get up about 12 or 15 days after the operation.

One of our patients developed a hypothermia which lasted about 12 days (rectal temperature was about 36 degrees C.); in another patient a slight pleural reaction with sterile exudate was noted, but this disappeared after puncture. In a third case, polyuria lasted for 3 weeks and the patient passed from 2100 to 2500 cubic centimeters of urine daily.

The operation may in truth be considered as not very dangerous. Twelve of our patients recovered without having shown a serious complication. One patient died on the third day as a result of a postoperative thrombosis of the aorta the result of an advanced atheromatosis of the aorta abdominalis and the iliac vessels.

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FROM A SURGICAL UNIT OF THE MELBOURNE HOSPITAL

OPERATION FOR THE CURE OF OBLIQUE INGUINAL HERNIA

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FOR nearly 30 years, R. Hamilton Russell has reiterated that oblique inguinal hernia is due solely to the partial or complete failure of obliteration of the processus vaginalis testis, but it is only recently that his views have begun to receive the recognition that they merit. Moreover, there are some surgeons who accept his theory but do not put it into practice in the operating theater.

Russell's theory may be summed up as follows: "No pre-formed sac; no oblique inguinal hernia." He has shown that mankind is divided into three groups: (a) those in whom the processus vaginalis is completely obliterated and who are, therefore, immune from oblique inguinal hernia; (b) those in whom there is partial or complete failure of obliteration of the processus and who are, therefore, potential cases of oblique inguinal hernia; and (c) those who actually suffer from oblique inguinal hernia.

It logically follows that the effective surgical treatment of oblique inguinal hernia depends upon the complete removal of the sac with as little interference as possible with the muscular structures of the region. The majority of surgeons still resort to more or less elaborate methods of suturing the inguinal region but such methods are based on the erroneous assumption that oblique inguinal hernia is due to muscular weakness. It is true that muscular weakness is the cause of a direct inguinal hernia, but it plays no part in the production of the oblique variety. In the operation for oblique hernia, these suturing methods are positively harmful because they weaken the abdominal wall in the inguinal region by converting muscle into non-contractile fibrous tissue and so predispose to the later development of a direct hernia. We have seen several such cases in the last few years. In the living subject the arched lower fibers of the internal oblique and transversalis muscles act as a sphincter; during effort they contract so that the gap seen in the cadaver between them and Poupart's ligament is obliterated. It seems to us illogical to interfere with this mechanism by the introduction of sutures.

If the sac be incompletely removed, recurrence of the hernia is probable, and the patient is discharged from hospital as a potential hernia case. Such a recurrence does not mean that muscular weakness is present and can be permanently cured by a second operation for complete removal of the sac. Failure to remove the sac completely is most likely when an interstitial process of the sac is present. Knowledge of the various abnormalities of the processus vaginalis, which have been well described by Hamilton Russell (2), will prevent the surgeon from making this mistake. In cases in which there is a very large hernia of long duration the musculature of the inguinal region is so weakened that it is necessary to repair it by some plastic operation, such as that elaborated by Gallie (1). The confidence engendered by the successful results of complete sac removal alone has made it rare for us to resort to such methods in oblique inguinal hernia.

The operation we perform is based on the method first described by Hamilton Russell (3). It is best performed under local anæsthesia. The skin incision is made parallel to and 1 inch above

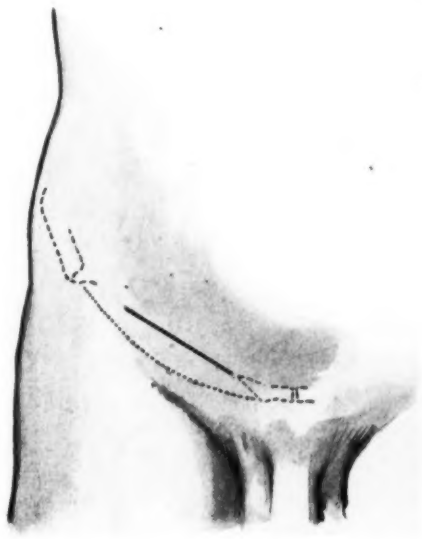

Fig. 1. Line of skin incision.

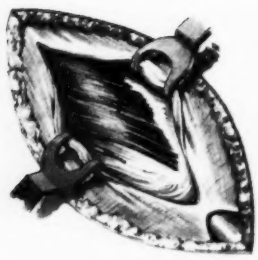

Fig. 2.

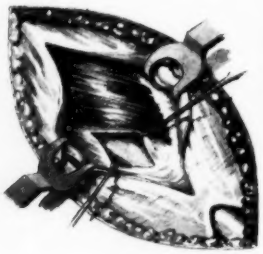

Fig. 3.

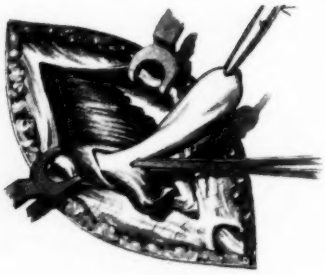

Fig. 4.

Fig. 5.

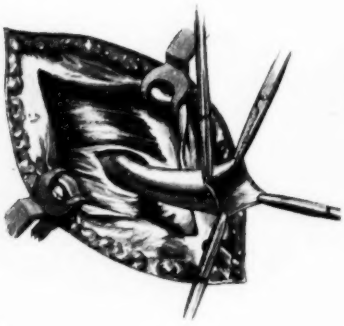

Fig. 6.

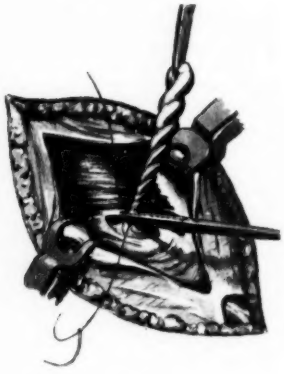

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 2. Incision made in external oblique aponeurosis and line of incision in cremaster indicated.
Fig. 3. Exposure of sac and cord after incision of the cremaster and underlying fascia.
Fig. 4. Separation of sac from the cord.
Fig. 5. Separation of adhesions around the neck of the sac.
Fig. 6. Sac opened for exploration.
Fig. 7. Traction, torsion, crushing, and transfixion of sac.
Fig. 8. Suture of opening in cremaster.
Fig. 9. Suture of external oblique aponeurosis.

Poupart's ligament, with its center over the internal ring (Fig. 1). It is unnecessary to carry this incision into the fatty tissue overlying the external ring, for the skin can easily be retracted inwards so as to expose the ring. An incision is then made in the external oblique aponeurosis in the line of its fibers without opening the external ring, thus leaving the intercrural fibers above this aperture intact (Fig. 2). A small incision is then made between the upper fibers of the cremaster and through the underlying fascia. The sac is thus exposed and is readily recognized lying upon the cord (Fig. 3). The cord is then delivered through the small opening and the sac separated from it by blunt and sharp dissection up to the level of the internal ring (Fig. 4). Since the secret of success of the operation lies in the complete removal of the sac, great care is necessary in defining its neck. While the sac is held firmly by forceps, the vas is separated from it on its inferior aspect until the external iliac artery is easily felt. Then fascial adhesions are separated above and to the outer

side of the internal ring by sweeping a gauze-covered finger under the arched lower border of the internal oblique (Fig. 5). The sac is then turned outward and the separation continued on the inner aspect of the internal ring until a small pad of fat, indicating the proximity of the urinary bladder, is exposed.

We attach considerable importance to the next step which consists in twisting the sac and at the same time pulling it forcibly upward in such a way that the peritoneum surrounding the internal ring is drawn into the twist. For this reason the sac has been previously opened (Fig. 6) so as to make sure that no viscus is adherent in the region of the neck. Traction is maintained on the twisted sac while crushing forceps are applied at its base. The latter is then transfixed and ligated with No. 1 chromic gut in the groove formed by the forceps (Fig. 7). The sac is cut across distal to the ligature, and the stump then retracts about 2 inches above the normal position of the internal ring.

Difficulty in identifying the sac may be experienced when the processus is open throughout (hernia into the tunica vaginalis; total funicular hernia: Russell, 2). The following has been found to be an easy, rapid, and sure method of overcoming this embarrassment: lift the cord up so that it lies across the palmar surface of the left index finger, separate the vas and the vessels from the remainder of the cord, and transfer them to the dorsal aspect of the finger. Lying upon the palmar surface of the finger will be the "remainder" in which the processus vaginalis must be located. Clamp this "remainder" in a pressure forceps and cut it across distal to the forceps. The forceps will now be grasping the upper portion of the divided processus, its open mouth will be seen, and it must be treated as the sac, i.e., by stripping up to the internal ring, by torsion, crushing, ligation, and removal. The lower portion of the processus leading to the tunica vaginalis testis should be disregarded in these cases.

The small opening in the cremaster is closed by a suture (Fig. 8). Three mattress sutures are then inserted in the incision in the external oblique aponeurosis (Fig. 9) and the skin wound is closed. The skin sutures are removed in 7 days and the patient is allowed to get out of bed in a fortnight.

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RETROGRADE DILATATION OF THE ŒSOPHAGUS FOR CARDIOSPASM[1]

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SINCE the introduction of improved methods of dilatation from above in cases of cardiospasm, it has seldom been necessary to dilate from below. In approximately 700 cases of cardiospasm at The Mayo Clinic, dilatation has been carried out readily and satisfactorily from above. In three cases the dilatation was done from below, one case in 1905, and two cases (those reported here) recently, within a few months of each other.

Cardiospasm has been defined as spasm of the musculature of the cardia or epicardia, sufficient to cause either partial or complete obstruction to the passage of food from the œsophagus into the stomach. It ranks next to carcinoma as the most common lesion found in the œsophagus. Purton first reported a case in 1821, and Zenker and von Ziemssen reviewed 17 cases from the literature up to 1878. Since that time, due to improved methods of examining the œsophagus, a great many more cases have been observed.

The etiology of the condition is not clear, since constant factors have not been found in any group of cases. Broadly speaking, there are two groups: (1) in which there is a sense of obstruction to the passage of food into the stomach without roentgen-ray evidence of obstruction; such patients are likely to show psychoneurotic tendencies, and (2) in which there is definite obstruction to the barium meal, although the symptoms may be as mild as in the first group; psychoneurotic tendencies are practically never manifested.

Plummer classified the disease into three stages: (1) cardiospasm without regurgitation of food, (2) cardiospasm with immediate regurgitation of food, and (3) cardiospasm and dilatation of the œsophagus with subsequent retention of food in the dilated part and its regurgitation at irregular intervals. Dysphagia, for both solids and liquids, is the most common symptom, in contradistinction to benign or malignant strictures. Nocturnal regurgitation, epigastric pain, which may antedate the onset of dysphagia, respiratory symptoms, and hiccough are often present.

Vinson and Plummer (1921) stated that it is possible to make a diagnosis of cardiospasm at any age, if dysphagia has existed for from 5 to 6 years without increase of symptoms, if the patient is having as much difficulty with liquids as with solids without a history of previous trauma to the œsophagus, and if roentgenograms reveal a smooth cigar-tip type of obstruction at the cardia with or without dilatation of the œsophagus. If, also, a No. 45 French olive can be passed into the stomach, guided by a previously swallowed silk thread without more than slight resistance at the cardia, the diagnosis can be made practically with certainty.

The only effectual treatment of cardiospasm consists in forcible dilatation of the cardia. In the earlier days such ineffectual measures as the general care of the patient, bromides, a non-irritating diet, the passage of sounds and, as a last resort, gastrostomy were tried. Russel (1898) was the first to report a large enough series of cases to show the value of dilatation of the cardia with a silk-covered balloon. Four of the seven patients treated in this manner were cured; one was greatly improved, one was not improved, and one was not treated long enough to be benefited. Russel mentioned that he had seen Loretta, of Bologna, stretch the cardia from below in cases of cardiospasm and suggested that this might be tried when dilatation from above failed.

Dilatation by the hydrostatic dilator has been used in practically all cases at the clinic, with good results. Dunham (1903) presented a method of dilating cicatricial stenosis of the œsophagus by having the patient swallow a silk thread, which is brought out through a gastrostomy opening. Mixter (1909) simplified the technique by having the patient swallow enough thread so that it would pass through the stomach into the intestine and permit of its being drawn taut when dilatation was attempted. Plummer (1910) mentioned the importance of the silk thread in œsophageal work. The hydrostatic dilator is guided over a previously swallowed silk thread. The amount of pressure used depends on the degree of dilatation of the œsophagus. If only slight dilatation is to be carried out, 20 feet of water pressure is used, whereas with more extensive dilatation, pressure to 24 feet of water, is reasonably safe. The pain the patient expe-

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Fig. 1. Case 1. Enormous dilatation and angulation of the œsophagus after barium meal.

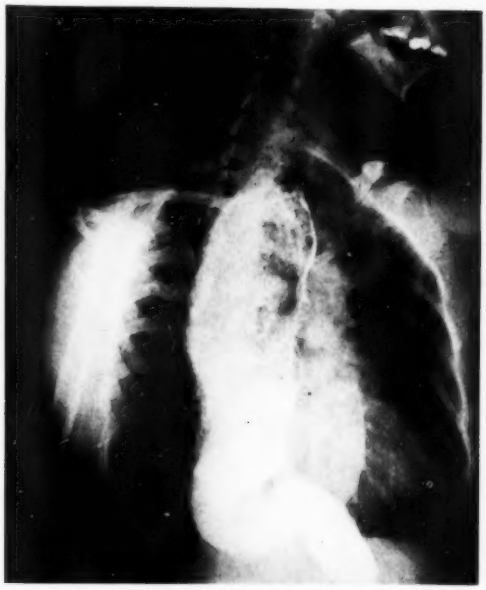

Fig. 2. Case 2. Marked angulation and dilatation of œsophagus.

riences may be a guide as to the limits of safety, but it is not infallible. One treatment by this method is effectual in 75 per cent of cases. In the remaining 25 per cent there is likely to be a return of trouble within a year, and relief is obtained by further dilatation.

Mikulicz (1904) reported 4 cases, 2 of more than one and a half years' duration and 2 of about 9 months' duration (after operation) in which he had dilated the cardia from below with good results. Mikulicz' idea in treatment by manual dilatation of the cardia was to produce an effect similar to that seen when any sphincter is stretched to the point of paralysis. Mikulicz introduced long curved forceps, the blades covered with rubber, through the gastrostomy opening. The forceps were worked into the cardia and gradually opened until the maximal distance between the blades reached from 6 to 7 centimeters.

Erdmann (1906) reported a case in which he had dilated from below with excellent results. He made an incision along the long axis of the stomach large enough to introduce his hand, but he was unable to locate the cardia. A bougie was then introduced from above through the cardia with the index finger following the bougie to the cardia. A second and finally a third finger was introduced, stretching the cardia from 4 to 6 centimeters. A year after the operation the patient had gained 35 pounds in weight.

REPORT OF CASES

CASE 1. A man aged 60 years came to The Mayo Clinic January 19, 1925, complaining of dysphagia of 38 years' duration. He dated the onset of trouble to drinking some cold lemonade, which caused a tight substernal sensation and was relieved by regurgitation of the lemonade. Since then cold liquids or solids had always seemed to lodge under the lower end of the sternum. At times he was able to force food down by taking a large amount of fluid. The trouble had persisted to a greater or less degree since the onset. He coughed and became quite blue with attacks of marked dysphagia and frequently regurgitated large amounts of mucus. He regurgitated food at night.

The patient weighed 145 pounds, a loss of 15 pounds compared to his weight at the onset of the trouble. A roentgenogram of the œsophagus showed cardiospasm with tremendous dilatation of the œsophagus.

Several attempts were made to dilate the cardia with the hydrostatic dilator, but the lower end of the œsophagus was so angulated that it was impossible to introduce the instrument into the cardia even with the guiding thread. It was then decided to dilate the cardia manually from an approach through the stomach.

August 10, 1927, exploration was carried out and gastrotomy performed. Following the thread, one finger and then two were introduced into the cardia, thus dilating the œsophageal opening considerably. The patient was relieved of dysphagia and fluoroscopic examination showed very slight lagging of the barium meal at the cardia. After

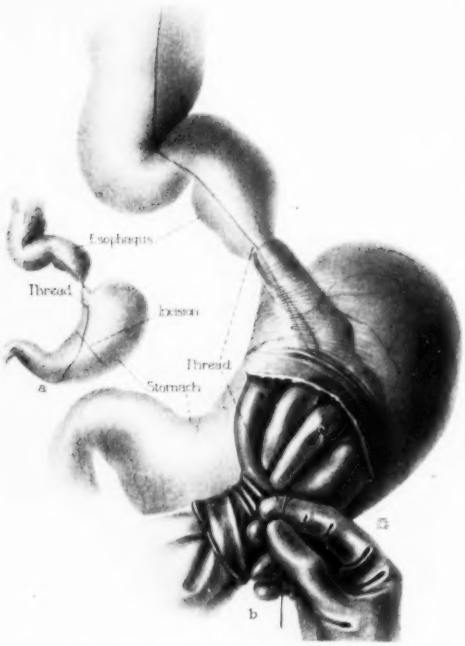

Fig. 3. Hand inserted through stomach with two fingers introduced into cardia, thread being used as a guide.

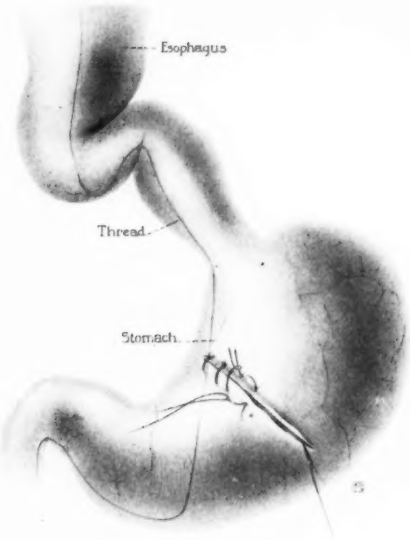

Fig. 4. Cardiospasm dilated and opening in anterior wall of stomach closed with sutures of chromic catgut and interrupted sutures of silk.

9 months there was mild recurrence of symptoms. The patient returned for re-examination in June, 1928, and at that time it was perfectly easy to introduce the hydrostatic dilator from above and effectually stretch the cardia. Complete relief followed this dilatation (Fig. 1).

CASE 2. A woman aged 52 years was first seen at The Mayo Clinic January 4, 1928. Her presenting complaint was abdominal pain of 30 years' duration. The symptoms at the onset consisted of gas, a sensation of fullness, and rather sharp upper abdominal pain coming on shortly after the taking of food. Seven years later urgent spontaneous vomiting without nausea developed. Her weight dropped from 105 to 90 pounds.

Fifteen years previously a roentgenogram had disclosed a pouch to the right of the œsophagus. The condition was diagnosed as stricture of the œsophagus and was dilated with bougies without relief. At this time the patient was having severe attacks of nocturnal awakening pains associated with vomiting and requiring morphine for relief. Seven years before examination she had hæmatemesis on two occasions a few days apart. Severe upper abdominal pain occurred frequently at that time and had persisted at irregular intervals since. On examination the patient was found to be moderately emaciated; she weighed 107 pounds. There was slight epigastric tenderness. The hæmoglobin was 67 per cent; urinalysis and Wassermann reaction on the blood were negative. A roentgenogram of the œsophagus showed cardiospasm with marked dilatation and tortuosity of the œsophagus (Fig. 2). An attempt was made on seven occasions to dilate the cardia from above with the ordinary hydrostatic dilator, but it was impossible to introduce the dilator into the cardia. In view of this, dilatation of the œsophagus from below was advised.

Exploration was carried out April 4, 1928. The stomach and gall bladder were normal. An opening was made in the stomach and the thread, which had been introduced through the cardia into the stomach from above, was followed up to the œsophageal opening. One finger was easily introduced into the cardia, but it was necessary to introduce the whole hand into the stomach to get two fingers into the cardia and dilate it. The opening in the stomach was closed with chromic catgut and silk. The patient convalesced uneventfully, leaving the hospital 16 days after operation. A roentgenogram taken about 3 weeks after operation showed diminution in the dilatation of the œsophagus and a good-sized opening into the stomach (Figs. 3 and 4). Three months following the operation the patient was eating all types of food without difficulty.

SUMMARY

With present-day methods of treatment, manual dilatation of the cardia through the stomach is seldom necessary but when used has proved successful.

Failure to dilate the œsophagus from above was due to marked angulation of the lower portion of the organ. Most cases of marked angulation, however, have been readily treated with the hydrostatic dilator, and symptoms have been relieved without any attempt at dilatation from below.

The silk thread is just as valuable a guide to manual dilatation from below as it is to dilatation from above, by means of the hydrostatic dilator.

In one case in which there was recurrence of symptoms following manual dilatation from below, the contour of the œsophagus had been altered sufficiently to permit hydrostatic dilatation from above.

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EXCISION OF THE THYROID ISTHMUS FOR RELIEF OF PRESSURE

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THYROIDITIS is a condition which certainly not infrequently terminates in myxœdema. Therefore, it is obvious that the removal of thyroid tissue in such cases is not to be desired, since the thyroid tissue that is still present is already infiltrated and limited in its capacity to produce thyroid excretion. Nevertheless, there are circumstances under which thyroiditis can and does produce symptoms which may be relieved by a surgical procedure.

Thyroiditis, with its round cell infiltration, its stone-like consistency, and its later scar contraction, occasionally produces constriction about the trachea sufficient in degree to occasion considerable discomfort. In considering how this constriction takes place, one must realize that the thyroid gland surrounds the trachea and is intimately adherent to it for at least two-thirds of its circumference (Fig. 1).

As the result of infiltration and contraction, many patients with thyroiditis complain of a marked sense of constriction in the throat with the advancing contraction of the organizing infiltration within the gland. In such cases, also, because of the stone-like hardness of the thyroid gland, a suspicion of malignancy arises, and the necessity of removing a portion of the gland for pathological examination and at the same time for relief of the constriction occasionally must be considered. In the presence either of carcinoma or thyroiditis, the removal of the isthmus of the thyroid, as shown in the illustrations (Fig. 2), accomplishes the results to be desired—the removal of the specimen and the relief of the constriction.

Little need be added to what may be seen in the illustrations except to urge that the entire isthmus be removed, not only that portion over the front of the trachea, but that extending downward toward the sides of the trachea, so that the entire front third of the trachea is bared and uncovered and so that sufficient thyroid tissue has been removed that the remaining lateral lobes are separately perched on either side of the trachea (Fig. 2), and so widely separated that they cannot bridge across the trachea, become united, and again produce constriction. The removal of the isthmus should extend well back into the body of the lateral lobes (Fig. 1), so that a small wedge is removed from the body of the gland. This makes it possible to bring the cut surfaces of the lateral lobes together (Fig. 3), thus controlling oozing and at the same time limiting the bridge of scar tissue in front of the trachea.

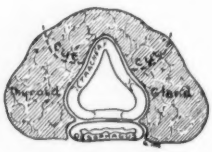

Fig. 1. Diagram showing the constricting effect on the trachea of the contracting gland. The dotted line indicates the segment of isthmus to be removed, the removal to extend back into the lobes of the gland.

The operation may be carried out through a short skin incision. There is very little bleeding to control, since the infiltration and contraction which accompany the thyroiditis markedly diminish the vascularity of the gland.

It may rightly be said that removal of the isthmus of the thyroid will frequently fail to include other portions of the gland in which carcinoma is suspected, but when such is the case, sections may readily be removed from any portion of the gland desired. Carcinoma of the thyroid gland, when it has invaded the parenchyma of the thyroid gland itself, is benefited but little by surgery. It is desirable, however, in many instances, to ascertain whether the induration of the thyroid is due to carcinomatous infiltration or to the induration associated with the infiltration of thyroiditis, since even that carcinoma of the thyroid which is hopeless from the point of view of surgical cure may be greatly benefited by X-ray treatment, and likewise, since thyroiditis markedly diminishes the secretory activity of the thyroid, it becomes extremely important that X-ray therapy should not be applied in thyroiditis, lest it lessen further a thyroid secretion already tending toward inadequacy.

There are certain features which are of assistance in endeavoring clinically to distinguish thyroiditis from carcinoma of the thyroid. Rarely may tenderness be elicited by pressure over the thyroid gland, which is the site of carcinomatous infiltration, while tenderness of some degree (usually slight) is rarely absent on pressure over the thyroid which is indurated as the result of thyroiditis. Carcinoma originating as it does so frequently from previously existing benign adenomata quite commonly involves only one lobe,

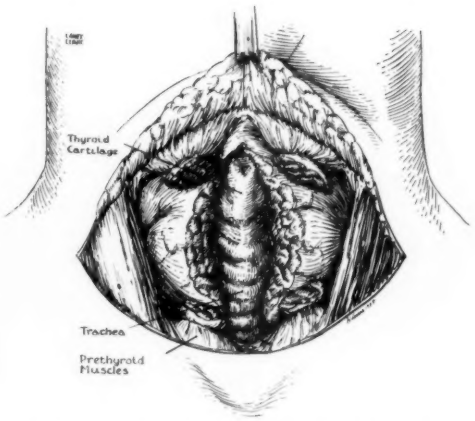

Fig. 2. Drawing showing the prethyroid muscles cut and ligated, the isthmus removed, and the entire front third of the trachea bared.

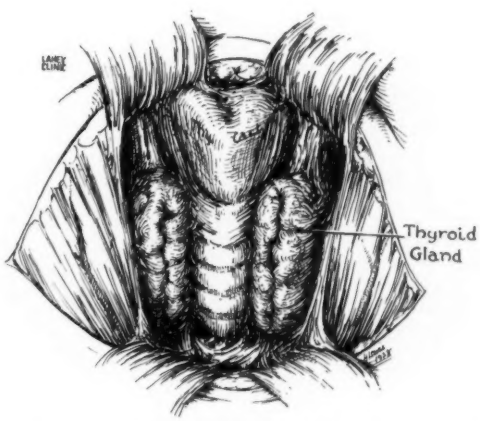

Fig. 3. The cut surfaces of the lobes have been sutured and widely separated so that they cannot be joined together again by scar and constriction thus recur.

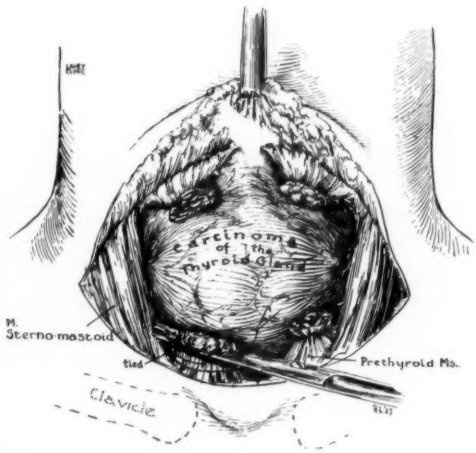

Fig. 4. Drawing indicating the relief from pressure which may be obtained (in carcinoma of the thyroid) by the severing and ligating of the prethyroid muscles. When possible, the isthmus should also be removed and the trachea bared.

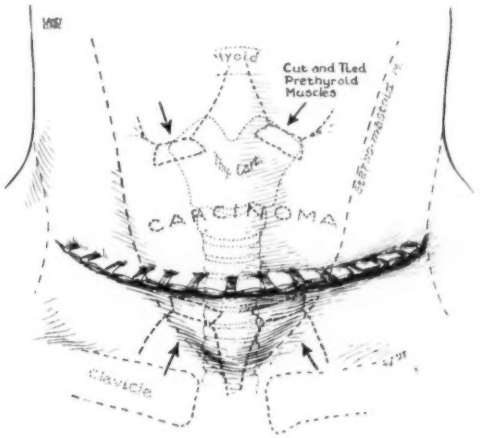

Fig. 5. The skin is closed over the ligature but ununited prethyroid muscles.

while that thyroid which is symmetrically firm and indurated throughout its entire extent is quite likely to be so as the result of thyroiditis, since the infiltration which accompanies this state tends to involve the entire gland rather than a lobe or a portion of it, as is the case with carcinoma, except in its late stages.

A feature of additional value in thyroiditis is the fact that in the presence of carcinoma not infrequently one lobe is first involved, and this lobe is considerably larger than the other and in addition there is a change in its relative consistency. Enlargement of the neighboring cervical lymph glands is not characteristically associated with thyroiditis, while with advancing carcinoma of the thyroid, the appearance of enlarged and indurated neighboring lymph glands eventually occurs, particularly when the carcinoma has already involved the parenchyma of the gland.

Since myxœdema so frequently eventuates in those patients whose thyroids are affected by

thyroiditis, and since so many patients with thyroiditis give histories of throat infections, two points should be emphasized: first, that as part of the plan of management of thyroiditis, all throat infections, particularly those arising in the tonsils, should be cared for as a means of eliminating continued infection; and, second, all patients with thyroiditis, and especially their families, should be warned of the probability of the later appearance of myxœdema whether any operation is undertaken or not, thus relieving oneself of the frequently inferred responsibility for the later thyroiditis.

Should the lesion prove carcinomatous, should it have invaded the parenchyma of the gland and have occasioned tracheal pressure and constriction as it so frequently does, then removal of the thyroid isthmus as here illustrated (Fig. 2) will give great relief, and with proper X-ray therapy it will often be possible for the patient to exist comfortably for several months or years.

Should the lesion prove to be carcinoma rather than thyroiditis, the procedure shown in Figure 4 should be employed, and in addition to removal of the thyroid isthmus, the ribbon muscles over the thyroid should be cut and tied close to their origin and the skin closed directly over the thyroid (Figs. 4 and 5). This results in such removal of pressure that considerable relief in breathing is often obtained in malignancy of the thyroid just as soon as the prethyroid muscles are cut. It perhaps has a slight further advantage in that more direct approach to the thyroid malignancy for X-ray therapy may be had with only skin interposed between the apparatus and the carcinoma of the thyroid.

SUMMARY AND CONCLUSIONS

Troublesome constriction about the trachea is not infrequently complained of by patients with thyroiditis.

Thyroiditis can be relieved by removal of the thyroid isthmus. The operative plan as employed in this clinic is illustrated and described in the legends.

It occasionally becomes necessary to remove a specimen for pathological report in cases suspected of thyroiditis or malignancy, in order that X-ray therapy may not further diminish the activity of an already inactive thyroid.

TRISACRAL FUSION

An Operative Technique Facilitating the Combined Ankylosis of the Lumbosacral Joints of the Spine and Both Sacro-iliac Joints[1]

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LUMBOSACRAL and sacro-iliac strains, subluxations, and irritative lesions have received much attention in the literature of the past 20 years. Widely divergent views relative to the differential diagnosis between these conditions are encountered. In general there is agreement on certain fundamental considerations and these may be summarized as follows:

1. Sacro-iliac and lumbosacral joints are true joints, and as such, are possible sites of lesions common to joints elsewhere in the body.

2. The lower lumbar and sacral regions are frequent locations of many and varied osseous developmental anomalies, as well as widely varying mechanical components of the supporting structures of the vertebral column.

3. There is still much confusion as to the diagnostic syndromes differentiating lesions of the lumbosacral juncture from those of the sacro-iliac joints.

4. Pathological conditions at both the lumbosacral juncture and the sacro-iliac joints frequently coexist and their separate evaluation is very difficult, if not impossible.

5. Relief of symptoms in many cases may be obtained from conservative measures, such as postural corrections, physiotherapy, rest, medical supervision, and external support. There are, however, many patients who are not relieved sufficiently or permanently and the resort to operative measures is justifiable.

6. Stabilizing operations of the lumbosacral and sacro-iliac joints have a distinctly useful place among the therapeutic measures directed toward the relief of symptoms arising from the pelvic girdle and lower spine.

In a paper published in 1913, Dr. J. E. Goldthwait makes the following statement: "If the sacro-iliac joint is involved as part of the lumbosacral malformation, it is obvious that treatment directed to the sacro-iliac joint will not bring relief. In such a case, not only must the sacro-iliac joint be supported, but at the same time the body must be so poised that there is the least possible irritation at the lumbosacral joint, as well as the least possible pressure of the transverse process against the sacrum and ilium." The terms "strain" or "irritation" might well be substituted for "malformation" in the foregoing quotation.

Operations eliminating motion of the lumbosacral or sacro-iliac joints have been devised and successfully employed by Hibbs, Albee, Smith-Peterson, Gaenslen, Campbell, Picque, Verrall, and others. All of these procedures, excepting that of Verrall, are directed toward the bony bridging or fusion of the joint and differ only in the location of the bony bridge and method of securing it. Verrall's operation utilizes a tibial graft as a tie beam between the ilia.

The following operation was devised to permit the bilateral stabilization of the sacro-iliac joints, as well as the fixation of the lumbosacral juncture. The complete bilateral stabilization of the sacrum encompasses more sound mechanical principles than procedures limited to but one or two of the three joints involved.

OPERATIVE PROCEDURE

The patient is placed prone upon the operating table with a small sand-bag under the lower abdomen, thus reducing the lumbar lordosis.

A transverse crescentic skin incision (Fig. 1) is made along the posterior margin of the iliac crests, crossing the midline one inch below the level of the posterior superior spine of the ilia. The subcutaneous tissues are divided along the same line until the gluteal and sacrospinalis fasciæ are exposed. The convex flap is then dissected from the fascia in the midline, only sufficiently to expose the tips of the spinous processes of the lower lumbar vertebræ. With proper retraction, this can be accomplished without a wide detachment of the skin flap. The margins of the concave flap are freed at their lateral ends thus giving a good exposure of the posterior superior spines of the ilia.

Lumbosacral fusion. This stage of the operation in detail closely follows the technique of the Hibbs' spine fusion operation. In brief, the steps are as follows:

A vertical incision (Fig. 2) is made, exposing the tips of the spinous processes of the fourth and fifth lumbar and first and second sacral vertebræ. The spinous processes of these vertebræ and contiguous laminæ are then completely exposed posteriorly by subperiosteal dissection, which is carried later-

[1] From the Orthopedic Service of Dr. E. W. Ryerson, St. Luke's Hospital and the Department of Orthopedic Surgery, Northwestern University Medical School.

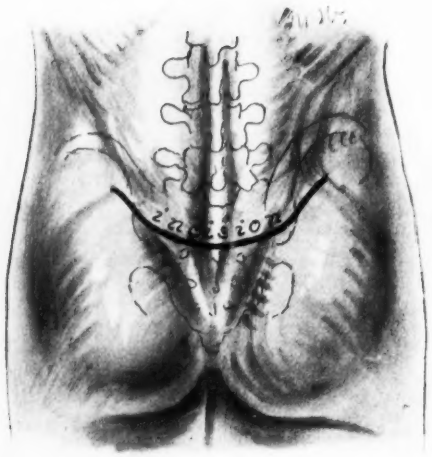


Fig. 1. Transverse incision through skin and subcutaneous tissue exposing lumbosacral and both sacro-iliac regions.

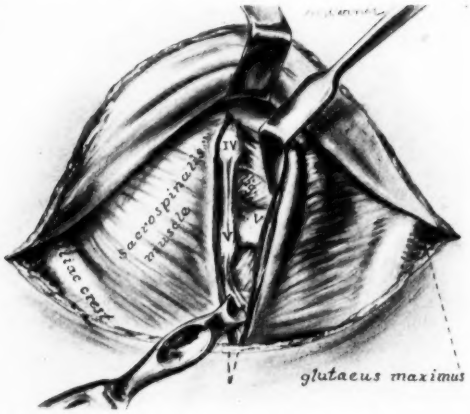


Fig. 2. Midline incision and subperiosteal dissection after the method of Hibbs. The lower lumbar and upper sacral segments are exposed subperiosteally. The interspinous ligaments are curetted.

ally, exposing the margins of the lateral vertebral articulations. The interspinous ligaments, as well as the ligamentum flavum, are carefully curetted from between the adjacent laminæ, and the cartilage of the lateral articulation is removed with a small curette or chisel. Bone bridges are chiseled from the adjacent margins of the exposed laminæ. These are interlocked, spanning the interlaminal spaces (Fig. 3). The spinous processes are partially amputated, but to a lesser degree than is done by Hibbs. The fragments of the spinous processes are broken down thus supplementing the laminæ bridges on either side. The midline incision is closed with two temporary sutures (Fig. 4) which approximate the fascia and periosteum.

Sacro-iliac fusion. The attachments of the gluteal and sacrospinalis fascia are freed as in Figure 4, thus exposing the posterior superior spine of the ilium. The posterior superior spine of the ilium is split parallel to its flat surfaces and the outer portion reflected laterally, hinged by periosteum and gluteus maximus muscle at the level of the posterior margin of the sacro-iliac joint (Fig. 5). The inner portion of the ilium is excised, and after the portions of the posterior sacro-iliac ligaments are divided, is removed from the wound and preserved in normal saline solution for later use. At this stage moderate hæmorrhage may occur, but it is readily controlled by hot packs and pressure, while the opposite joint is attacked in a similar manner.

The periosteum of the posterior surface of the sacrum is elevated toward the midline (Fig. 6) and the cortex of the sacrum roughened by means of a small gouge. The posterior margin of the cartilage of the sacro-iliac joint presents in the depth of the wound and is curetted thoroughly. Chips of cancellous ilium are placed across the sacro-iliac joint posteriorly, and the reflected bone flap of ilium is turned against the roughened surface of the sacrum and the periosteum of both iliac bone flap and sacrum is sutured (Fig. 7). The iliospinalis and gluteal fasciæ are then closed securely. The opposite sacro-iliac joint is attacked in a similar manner. The excised portion of ilium not used for chip-grafts is split into two portions and placed through the midline incision so that it lies adjacent to the stumps of the spinous processes (Fig. 7). The midline and lateral incisions are closed (Fig. 8) and the skin incision sutured with interrupted chromic catgut. A dressing and pad are applied and covered with oiled silk.

The details of technique were worked out by repeated operation on the cadaver and have been found to be very satisfactory on subsequent clinical use.

The attached cancellous bone flap of ilium makes an ideal graft, as it replaces the central portion of the posterior sacro-iliac ligament. Increased instability of the sacro-iliac joint, theoretically present after division of the posterior iliac spine, could not be demonstrated on the fresh

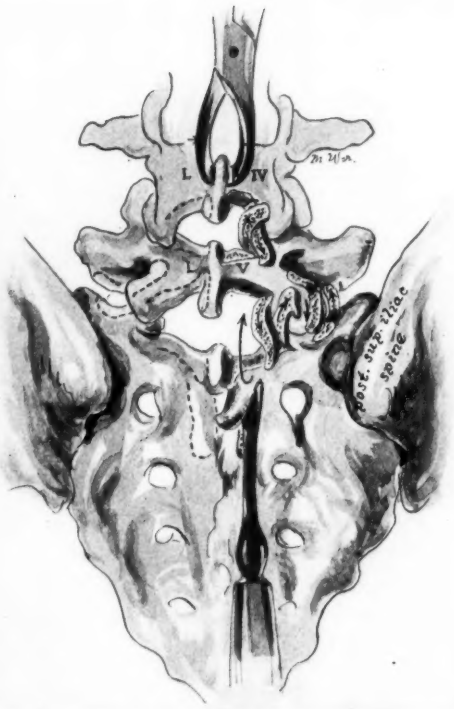


Fig. 3. Bony bridges are turned up spanning the interlaminal spaces. The lateral articulations are curetted and the spinous processes are partially amputated.

cadaver by direct manual pressure or by manipulation of the femur.

The operation of trisacral fusion makes possible the bony consolidation of the ilia, sacrum, and lower lumbar vertebræ. It has been found most practical to fuse the last two lumbar vertebræ to the sacrum, although the extent of fusion should be determined by the individual case.

REPORT OF CASES

Case 1. April 22, 1926. E. McG., age 41 years, single, nurse. Patient complained chiefly of pain in the lower lumbar region. She had had sciatic pain for 8 months. Eight months ago, she first noticed pain in the lower back, especially while in bed or when she sat. She was moderately relieved on standing. At first the pain was of a dull aching character localized in low back. Later there was distinct radiation down the posterior aspect of the left thigh and leg and to the toes of the left foot. The pain gradually increased in severity and more recently has extended down the right sciatic region. Tonsillectomy had been done in 1924; otherwise her past history was negative.

Examination reveals a well nourished woman, moderate amount of dental work, tonsils removed, sinuses negative, lungs clear, heart normal, extremities negative, reflexes normal. The spine shows no lateral deviation but a moderate increase of normal curves. Flexion, lateral bending, and extension are restricted in the lumbar region. Acute tenderness to firm pressure is elicited in midline at lumbosacral juncture. No tenderness is noted when iliac crests or trochanters are compressed. Distinct lumbar pain is present on straight leg flexion at hips. The urine is normal. Temperature 98.6 degrees.

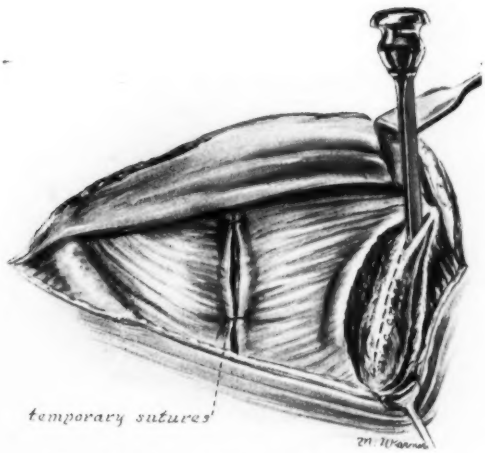


Fig. 4. The midline incision is closed with temporary sutures. The posterior iliac crest and spine are exposed and split to the level of the posterior margin of the sacro-iliac joint.

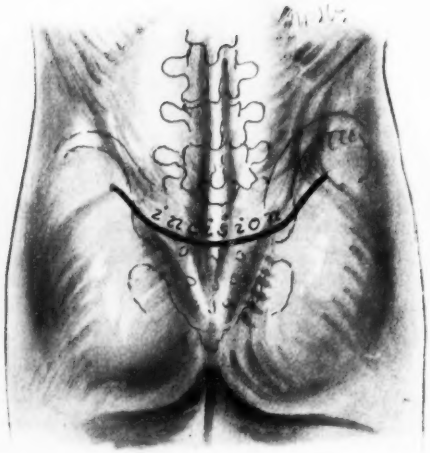
X-ray examination shows a moderately marked sacralization of the transverse processes of the sixth lumbar vertebra. The body of the fifth lumbar vertebra is slightly angulated downward to the left on the upper surface of the sixth. The lateral articulations at this level are irregular and without detail. Both sacro-iliac joints are widened and sclerosed with some spur formation at the inferior margin.

Diagnosis: chronic lumbosacral and bilateral sacro-iliac strain; chronic secondary arthritis of these joints.

Operation, April 23, 1926. Fusion of the fifth and sixth lumbar and first sacral vertebræ was done as well as fusion of the right sacro-iliac joint, by the method described. The left sacro-iliac joint was fused by the Smith-Peterson technique.

The postoperative course was normal except for urinary retention for the first 4 days. Patient was allowed up during eighth week. X-ray films show heavy callus at lumbosacral and at both sacro-iliac joints. The result 18 months after operation is excellent; patient has complete relief of symptoms.

Case 2. Mabel B., 26 years old, married. Patient complained chiefly of pain in the lower lumbar region, the presence of which dated back 10 years to the birth of a child. The pain is limited to the lower lumbar region. There is no sciatic radiation. This patient was first seen by the author about 18 months previous to admission to hospital. At that time a diagnosis of chronic arthritis and strain was made. The patient was referred to Dr. H. O. Jones for gynecological care. An extensive pelvic and perineal repair was done but without any appreciable relief of low back symptoms. The patient was fitted with a corset, which



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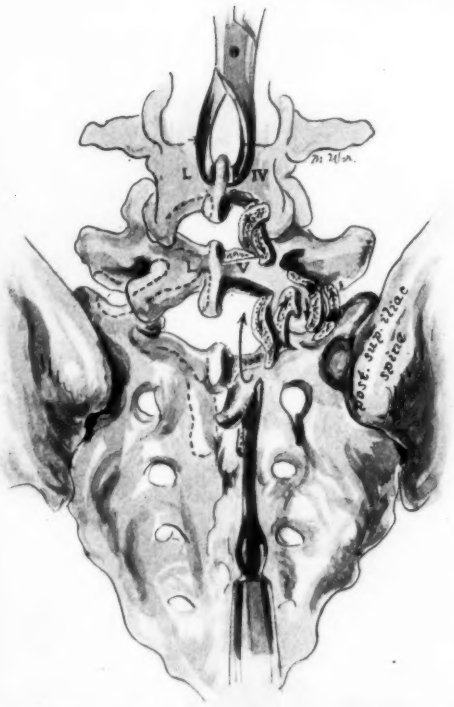

Fig. 3. Bony bridges are turned up spanning the interlaminal spaces. The lateral articulations are curetted and the spinous processes are partially amputated.

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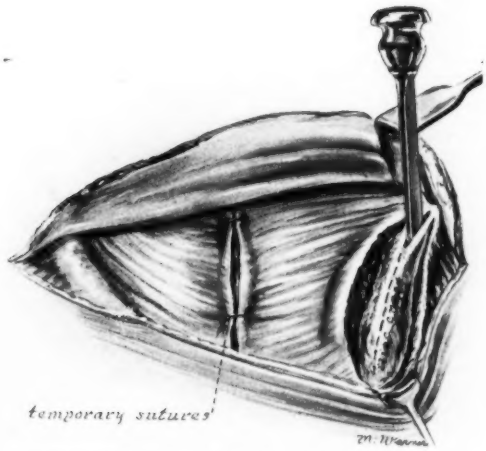

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Diagnosis: chronic lumbosacral and bilateral sacro-iliac strain; chronic secondary arthritis of these joints.

Operation, April 23, 1926. Fusion of the fifth and sixth lumbar and first sacral vertebræ was done as well as fusion of the right sacro-iliac joint, by the method described. The left sacro-iliac joint was fused by the Smith-Peterson technique.

The postoperative course was normal except for urinary retention for the first 4 days. Patient was allowed up during eighth week. X-ray films show heavy callus at lumbosacral and at both sacro-iliac joints. The result 18 months after operation is excellent; patient has complete relief of symptoms.

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Fig. 5. The external portion of the ilium is reflected laterally and the internal portion excised.

enabled her to do her housework. The low back pain persisted but to a lesser degree. She was admitted to the hospital April 16, 1928.

Examination revealed negative findings except for the limitation in all directions of movements of the lumbar spine, tenderness to pressure over the lumbosacral juncture and both sacro-iliac regions and pain on either side of the lumbar region produced by straight leg flexion.

Diagnosis: chronic lumbosacral and sacro-iliac strain with secondary arthritis.

Operation, April 23, 1928, consisted in fusion of the lumbosacral and both sacro-iliac regions by technique described. Postoperative course was very normal. Patient was allowed up after the sixth week, wearing corset.

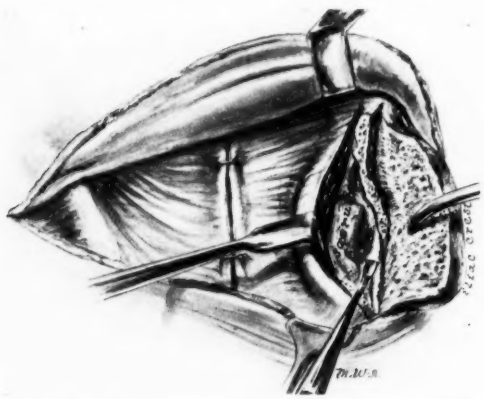

Fig. 6. The periosteum of the sacrum is reflected medially and the cartilage of the sacro-iliac joint curetted. Cancellous bone chips fill the iliosacral angle.

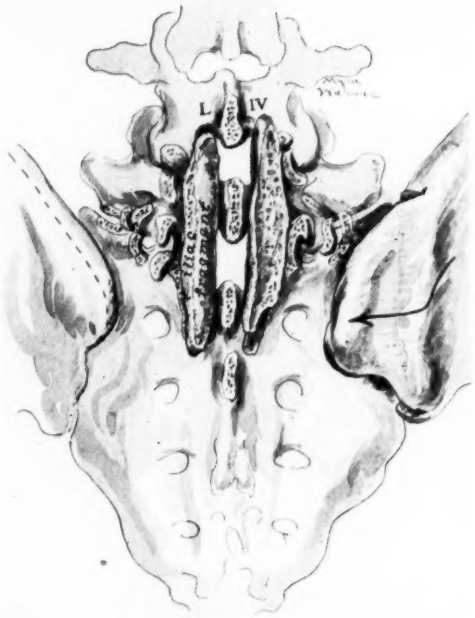

Fig. 7. The reflected portion of the ilium is brought medially covering the posterior portion of the sacro-iliac joint and sutured to the periosteum of the sacrum. The excised fragment of the ilium is divided and placed to re-inforce the spine fusion operation.

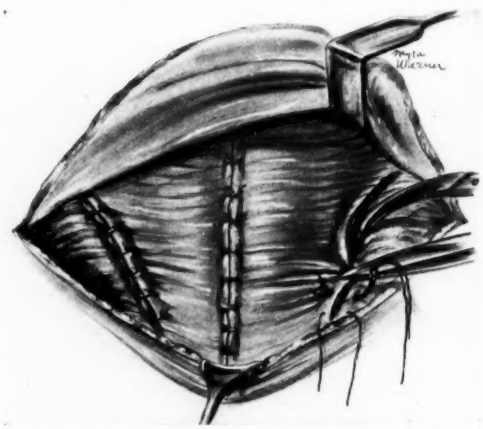

Fig. 8. The iliolumbar fascia is closed in the midline and the iliolumbar and gluteal fasciæ sutured firmly prior to skin closure.

X-ray films taken on February 22, 1927, showed the lateral articulations between the fifth lumbar to be of the oblique type. The joint margins were irregular and showed much new bone formation. Both sacro-iliac joints were widened. The margins of the sacrum and ilia were distinctly sclerosed with small areas of localized bony absorption of the joint surfaces at the antero-inferior aspect of the joints.

June 16, 1928. There is evidence of new bone formation between the fourth and fifth lumbar and first sacral vertebræ. There is also evidence of bone production over the posterior aspect of both sacro-iliac joints.

July 20, 1928. Patient is completely relieved of backache. There is some stiffness of the erector spinæ muscle groups. Movements of back are nearly normal and are painless. The patient states that she is very well pleased with outcome of operation and that she is more comfortable than she has been for the past several years. It is too early to predict end-result, but present result is most excellent.

Case 3. H. C., age 17 years, student, was admitted to the hospital May 23, 1928. One year ago he first noticed pain in the lumbar region after running into a fence while playing ball. Since that time he has had increasing discomfort in the lumbar region, with frequent sharp radiation of pain down the posterior aspect of the right thigh to the level of the knee. He has been under the care of several physicians, without securing relief. General history is otherwise negative except for surgical treatment of polydactylisim.

General examination was negative. Examination of the spine revealed marked spasm of the erector spinæ muscles, moderate lumbosacral scoliosis to the left, distinctly limited flexion and extension of the lumbar spine, somewhat freer lateral bending, distinct tenderness over both sacro-iliac joints, and at lumbosacral juncture, some tenderness along the course of the right sciatic nerve, some referred pain in the sacro-iliac region on compression of the iliac crests, and normal reflexes.

X-ray films taken May 11, 1928, show moderate spina bifida occulta of the first sacral vertebra, moderate sacralization of the left transverse process of the fifth lumbar, moderate sclerosis along the margins of both sacro-iliac joints, and the lower portion of the sacrum and coccyx irregular and deviated to the left.

Diagnosis: sacralization of fifth lumbar vertebra, chronic lumbosacral strain, chronic sacro-iliac strain.

Operation consisted in fusion of the fourth and fifth lumbar and first sacral vertebræ, bilateral sacro-iliac fusion, by technique described. Postoperative course was uneventful. Patient was allowed up after 6 weeks, wearing reinforced fabric corset.

X-ray examination: July 13, 1928, showed much new bone present over posterior aspect of fourth and fifth lumbar and sacrum, as well as over both sacro-iliac joints.

Result: immediate complete relief of pain in low back. This case is too recent to be considered as final result.

Case 4. B. B., female, single, aged 40 years, weight 145 pounds. Patient complains of weakness of lower lumbar region which has been present for past 20 years, and acute disabling pain in lower lumbar region since a fall downstairs 6 months ago. Previous to injury patient was enabled to carry on a normal existence by the use of a firm corset. Since injury brace and corset have been of no avail. The pain has been limited to the lumbosacral region posteriorly, especially in the midline. Radiation of pain is absent. Some relief is experienced on lying down, but on standing, symptoms are increased. General health is good.

Patient had had measles at 10 years, fracture of elbow at 2 years, operation for delayed ulnar palsy 5 years ago, appendectomy 14 years ago.

General examination discloses essentially normal findings with teeth, tonsils, and sinuses negative. The abdomen is normal except for scar in the right lower quadrant, and there is a scar over the left ulnar groove. Reflexes are normal. The lower extremities are equal in length.

Lateral alignment of the spine is good. Slight dorsal round back is present. Lumbar lordosis is moderately increased. Movements of the upper spine are free in all directions. Flexion, extension, and lateral bending are limited by muscle spasm and pain especially if passive flexion is attempted. Tenderness is marked when pressure is exerted over the spinous processes of the last lumbar and first sacral vertebræ. No tenderness is elicited on compression of the iliac crests or the trochanters. Straight leg flexion causes pain in the lumbosacral region and behind the knee. No tenderness is present along the sciatic nerves.

X-ray examination of the fifth lumbar vertebra shows a symmetrical sacralization of the transverse process which is very marked but not complete. Both sacro-iliac joints are widened and the joint surfaces sclerosed.

Operation, July 5, 1928, consisted in trisacral fusion—fusion of fourth and fifth lumbar and first and second sacral vertebræ, bilateral sacro-iliac fusion. The immediate result was excellent. The time elapsed since operation is entirely too brief to judge the final outcome.

Case 5. Mrs. E. S., aged 41 years, mother of three children. Patient has had right sciatic pain for 10 years. Pain is intermittent in character, its onset abrupt and sharp, beginning in the posterior aspect of the right hip and radiating along the posterior thigh region and posterolateral aspect of the leg. The pain becomes worse when she sits and she prefers to stand or lie down. When riding, she found that she was more comfortable if she sat with her right foot under her. About 4 months ago, severe pain began in the lumbosacral region. This was accompanied by a "slipping" sensation in her lower back. The sciatic pain became distinctly worse at this time and there were occasional radiations down the left sciatic region.

Patient has had no severe illnesses. Her upper teeth were extracted 6 years ago, and she had tonsillectomy 1 year ago.

Examination shows a moderately obese woman in good general health. General examination is negative except for moderate amount of dental work. The sinuses were normal. The back shows moderate obliteration of lumbar lordosis. There is no lateral deviation of the spine. Motion is restricted in all directions at the lumbosacral juncture. Tenderness is marked over both sacro-iliac joints, as well as in the midline at the fifth lumbar vertebra. Straight leg raising causes pain in both sacro-iliac regions as well as at the lumbosacral juncture.

X-ray examination shows that both sacro-iliac joints are slightly widened and the bony surfaces are distinctly sclerosed. Small spurs are present at the lower margin of the left sacro-iliac joint. The lateral articulations of the lumbosacral juncture are of the cervical type. On the right, a large irregular osteophytic reaction involves the joint and extends laterally. There is partial ossification of the iliolumbar ligaments. Lateral view shows a normal lumbosacral angle.

Operation, May 21, 1928. The fourth and fifth lumbar and first and second vertebræ were fused. Both sacro-iliac joints were fused, the technique described being used. The postoperative course was normal except for urinary retention which cleared after 6 days.

This series of five cases of "trisacral" fusion is too short and of too recent date to judge as to end-results. The immediate results are very encourag-

ing and justify the employment of this operation in a longer series. The heavy callus formation at the lumbosacral juncture shows the advantage of using the iliac transplant. The fusion of the lumbosacral joints is much more difficult to demonstrate by means of the X-ray. Clinically, fusion has occurred in all of this series.

SUMMARY

A new operative technique for the combined stabilization of the sacro-iliac and lumbosacral joints is described. The immediate results in a series of 5 cases are such as to warrant the more extensive trial of this procedure as a means of relieving low back and sciatic pain.

No attempt has been made to discuss the symptoms or detailed etiology of low back or sciatic pain. The reader is referred to the vast volume of literature on this subject published during the past 20 years.

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THE RESULTS OF TREATMENT OF TUMORS OF BRANCHIOGENIC ORIGIN

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A SURVEY of our 7,376 records shows that there occurred, since 1914, eighteen cases of tumors which I believe were of branchiogenic origin. Two of these were benign and sixteen were epithelioma (squamous cell carcinoma), making the incidence of malignancy 0.2 per cent.

These sixteen cases were of importance in that a careful study of their records showed that they were of exceedingly rapid growth, during which time some of them were suspected to be of an inflammatory nature and were dealt with by their physicians by incision to evacuate a supposed abscess. The age incidence of these malignant tumors is depicted in Table I. Fifteen of these cases occurred in males, one in a female. Two gave a positive blood Wassermann reaction. Hereditary history of cancer was obtained in two cases and in one case the wife had died many years before of cancer of the uterus. There was no history of trauma. From their histories these patients complained of pain or stiffness in the neck, swelling which had existed from a few weeks up to one year. In two instances the patient records a swelling which grew rapidly, then subsided somewhat and was followed by another period of rapid growth. At the time of admission, seven patients had ulcerating masses and three had brawny, hard, or indurated masses with areas which felt cystic. The tumor occurred on the right side of the neck twelve times, on the left side four times, occupying sites from the angle of the jaw to the clavicular insertion of the sternocleidomastoid muscle. The submaxillary region and the middle third of the sternocleidomastoid muscle seem to be the most common sites. Before admission these patients were subjected to operation in five instances, to incision for the evacuation of pus on two occasions. Plasters, poultices, and X-ray treatment had been given in six cases.

Fig. 1. Case 10932. Died as the result of œdema of the larynx.

Fig. 2. Case 9544 shows an ulcerating lesion which had been incised for abscess.

Ewing[1] in his text book *Neoplastic Disease* and Carp and Stout[2] in a recent and very comprehensive paper entitled "Branchial Anomalies and Neoplasms" call attention to the difficulty in diagnosis. I fully realize that the diagnosis of epithelioma of branchiogenic origin must be arrived at after careful consideration of the possibility of primary growths in the nasal cavity or sinuses, pharynx and oral cavity, larynx and upper end of the œsophagus. In the study of these cases, both clinically and on four occasions at postmortem, we were unable to find any primary growth in these regions. The microscopic examination of the tissue removed at the time of operation, or of biopsy material, was reported as epithelioma (squamous cell carcinoma), pearl formation being noted in a few sections. In cases which came to autopsy metastases were noted in the regional lymph nodes and mediastinal nodes on one occasion.

The two patients who had branchiogenic cysts are alive and well as the result of operation. Of the sixteen malignant cases, in five the tumor mass was removed, in two it had been incised by the family doctor for supposed abscess; and in all the remaining cases biopsy was performed. Radiation therapy consisting of large radium packs or high voltage X-ray proved only palliative in one case and of no avail in the others. The longest palliation was one year. No apparent clinical cures have been effected by any form of treatment in these cases.

[1] EWING, JAMES. Neoplastic Diseases, 1928, p. 1023. Philadelphia: W. B. Saunders & Co.

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TABLE I.—AGE INCIDENCE OF MALIGNANT BRANCHIOGENIC TUMORS

Years	Cases
20 to 29	1
30 to 39	1
40 to 49	0
50 to 59	9
60 to 69	5

Of the five cases in which radical operation had been done followed by radiation treatment, all died in from 3 to 9 months after treatment, unimproved.

The two patients subjected to incision for abscess and treated with high voltage X-ray died within 4½ months after treatment, unimproved.

The nine patients in whom biopsy examinations only were made and who because of inoperability were treated with high voltage X-ray or with large radium packs, died within 1 to 3½ months after treatment, unimproved, except one who was relieved somewhat for one year.

CONCLUSIONS

1. Branchiogenic epithelioma represents 0.2 per cent of the malignancy in our experience.
2. This disease occurs much more frequently in the male.
3. It occurs most commonly in and after the fifth decade.
4. Mistaken diagnosis for inflammatory lesion is common.
5. All forms of treatment, whether surgery or radiation, have been only palliative.

CONGENITAL VALVULAR OBSTRUCTION OF THE PROSTATIC URETHRA

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ALTHOUGH congenital valvular obstruction of the prostatic urethra was recognized 135 years ago, it has received very little attention in the medical and surgical literature so that it seems timely that we bring together a complete study of the cases that we have had at this clinic.

The credit for first recognizing the condition is given by earlier writers on the subject to Conrad Johann Martin Langenbeck, who is supposed to have published in 1802 a drawing of posterior urethral valves in his monograph "Ueber ein einfach und sicherer Methode des Steinschnittes." Velpeau, 30 years later, in 1832, in his surgical anatomy, and Jarjavy in 1856, in his monograph on the urethra, refer to this diagram of Langenbeck. Velpeau's allusion to the subject is as follows: "The verumontanum in prolonging itself backward to form the uvula vesicæ sometimes expands and gives rise to two lateral folds which present in fact the appearance of two very thin valves. . . . In passing forward toward the membranous portion the crest now and then presents a similar predisposition. This does not appear to be a very rare occurrence for we have met with it three times, and it is delineated by Langenbeck in his treatise on lithotomy published in 1802." What Velpeau probably refers to is diagram V in this article. A longitudinal section of the urethra is shown and the valves are very vaguely outlined. They are not described. Velpeau does not give descriptions of the three cases mentioned. Jarjavy gives very excellent descriptions and anatomical diagrams of valves in the several portions of the urethra.

In 1840 Budd described an autopsy in which bilateral hydronephrosis, hydro-ureters, and a hypertrophied and dilated bladder were found. Examination of the urethra showed valvular obstruction which he described as being in the membranous urethra. He says:

> The individual who is the subject of this paper was a sailor, age 16, who entered the hospital in a state of unconsciousness and died a few days after his admission. When the abdomen was opened the kidneys were found to be very much dilated. They were nothing less than pouches containing about a pint of liquid apiece. The ureters were dilated to the size of one's thumb from the pelvis of kidney to their entrance into the bladder. The ureters were so folded at their juncture with the bladder that no reflux up the ureters occurred when pressure was made on the bladder. The bladder was dilated and had trabeculæ similar to the endocardium.
>
> There was found in the urethra, attached to its roof, a valve of mucous membrane analogous to the valves in veins or the semilunar valves of the heart, immediately behind the bulb of the urethra. This valve formed during the patient's life an obstruction to urine flowing out of the bladder, without presenting an obstruction to the passage of a catheter. Behind the valve the urethral canal appeared normal.

Budd in the discussion said that he thought the membrane congenital.

In 1840 Bednar described an autopsy on a premature stillbirth which showed two concave folds in the urethra which came off from the lower end of the verumontanum and were associated with dilatation of the bladder, bilateral hydronephrosis, and renal atrophy. The valves were described as follows:

> The verumontanum divided at its forward end into two folds of mucous membrane, crescentic in shape and with their concavity directed toward the bladder. A probe could be passed from below through the valves. Pressure on the bladder ballooned them out thus closing the lumen between. There was bilateral hydro-ureter and bilateral hydronephrosis.

Goudard described similar cases in 1854.

In 1855 Picard described a case in a man 40 years of age who presented symptoms of difficulty of urination, and uræmia, with convulsions. Examination showed a markedly distended bladder and subsequently autopsy showed urethral valves springing from the verumontanum with bilateral hydronephrosis and hydro-ureters. This is, apparently, the first case in which valves have been discovered in an adult.

The first illustration of the condition, drawn from an actual specimen, to be found in the literature is in a report of Tolmatschew who, in 1870, described an autopsy in which he found two urethral valves springing from a point just below the verumontanum (Fig. 1).

Eigenbrot in 1891 reported a case of valvular obstruction of the vesical orifice, but apparently the fold of mucous membrane was intravesical and not in the posterior urethra.

Poppert in 1892 described a case in a man 24 years of age who had had difficulty in urination since childhood. Urethrotomy showed an obstruc-

tion near the vesical orifice which was thought to be produced by a fold of the mucous membrane. A retention catheter was inserted, but the patient died the following day. Autopsy showed a fold of mucous membrane coming from the vesical neck in the form of semilunar valves which caused obstruction, bilateral hydronephrosis, and hydroureters. The case is illustrated. The valve measured ¾ centimeter in diameter and its free surface was 1½ centimeters in circumference. The internal sphincter was dilated. He stated that undoubtedly the condition was congenital.

During the next 17 years personal cases were reported by sixteen separate observers, all in infants under 5 years of age except one case, that of Lederer, in a boy 11 years old. In this case autopsy showed a diaphragmatic membrane below the verumontanum with bilateral hydronephrosis.

Up to this time all cases have been found at autopsy or accidentally at operation. A brief description of apparently the first case in which the condition was seen with a cystoscope follows:

The patient, aged 17, was admitted to Johns Hopkins Hospital on November 11, 1912, complaining of urinary difficulty since birth. He had to void every 2 hours during the day and once at night. There was no history of pain or incontinence. For one month his vision had been bad. The patient was sallow but the general physical condition was otherwise negative. Catheter passed with ease and found 475 cubic centimeters of residual urine. The bladder capacity was 750 cubic centimeters. The cystoscope passed easily encountering no obstruction in the prostate. The bladder was considerably trabeculated and the right ureteral orifice was widely dilated. Examination of the urethra with the cysto-urethroscope disclosed a prominent ridge coursing along the urethral floor in its mid-line between the external sphincter and the verumontanum. This ridge ended in the verumontanum, which was normal in size. The upper aspect of the verumontanum was bifurcated and from it were continued two thin folds of tissue which were apparently attached to the floor and lateral walls of the urethra, evidently congenital valves of the verumontanum. Neither ejaculatory duct could be seen. Following this instrumental examination the patient voided urine much more freely and his former urinary symptoms largely disappeared. He lived for a year with no return of his former symptoms and died of pneumonia. Autopsy was obtained (Fig. 2) and showed a dilated bladder. The right ureteral orifice was 1.5 centimeters in diameter. The right ureter measured 4 centimeters in diameter and was very tortuous. The right renal pelvis was greatly dilated with complete atrophy of the kidney; there was moderate hydronephrosis and hydro-ureter on the left side; the internal sphincter was dilated and just beneath the median portion of the prostate was a slit-like opening which extended from the vesical orifice to the level of the verumontanum. A probe passed into this for a distance of 1 centimeter. The verumontanum was bifurcated, the cavity extending toward the bladder. From each leg of the "V" that continued upward toward the base of the bladder, fibrous ridges extended for at least 3 millimeters from the floor of the urethra. These ridges bounding the slit-like cavity described above, ended in the region of the internal sphincter, which appeared to be widely dilated. On examination of the remainder of the posterior urethra only slight, if any dilatation, was seen. From the lower aspect of the verumontanum and coursing along mid-line of the urethral floor was a fairly prominent, longitudinal ridge of tissue which rose from the floor of the urethra for about 1 millimeter.

This is apparently the first case in which the valves and obstruction produced by them have been recognized cystoscopically.

We quote here a description of the first successful operation, from Young's *Practice of Urology*.

The first case in which a congenital valve of the prostatic urethra was cured by operation was that of a patient who came to this clinic on August 25, 1913. He was 20 months old and had from birth suffered from great difficulty and frequency of urination. Examination disclosed a greatly distended bladder. Attempts to pass catheters and sounds were unsuccessful, owing to an obstruction deeper than the external sphincter, and thought to be at the prostatic orifice. A filiform was readily passed into the bladder, after which a ureteral catheter was passed and a large amount of residual urine was recovered in this way. The phthalein showed only a trace for the first two and one-half hours and only 30 per cent for 6 hours. A thorium cystogram showed dilatation of the prostatic urethra and a diagnosis of obstruction in the anterior part of the prostatic urethra was made. October 13, 1913: Operation, Young; suprapubic cystostomy. The vesical orifice was found to be dilated and just beyond it in the prostatic urethra was a small vertical valve-like obstruction which was semilunar in outline, and extended from the floor to the roof. It was readily seized by a clamp, pulled into the bladder, and destroyed with electrocautery. After that instruments could easily be passed from the meatus into the bladder. The valve had been completely destroyed. The patient made an excellent recovery.

This case was reported by Young to the Johns Hopkins Hospital Medical Society in November, 1913, and was apparently the first clinical recognition and operative cure of congenital valve of the prostatic urethra.

The second operation on congenital valves was performed one month later.

The patient was 21 months old and had had difficult and painful urination for 10 months with occasional marked distention of the bladder, sometimes going 36 hours without voiding. A ureteral catheter was finally passed and 500 cubic centimeters of residual urine obtained. Phthalein test was good, 71 per cent for the first hour. A diagnosis was made from the obstruction encountered in the posterior urethra, when an attempt was made to pass catheters and sounds. At operation (Young), the prostatic orifice was again found to be dilated and when a sound was passed into the urethra a membrane could be seen covering the end of the sound. This could be palpated with the finger and was recognized as a thin diaphragm. A large probe finally passed from the urethra into the bladder and a perineal incision was then made in the bulbous urethra, and from there instruments were passed which ruptured the valves and produced free passageway through the urethra into the bladder for large instruments.

It seems evident now that the perineal incision was entirely unnecessary. A good result was obtained however.

The next case in which valves were recognized by cystoscopy and urethroscopy and confirmed by cystogram which showed for the first time the greatly dilated ureters and pelves which are characteristic of this condition was that of a boy admitted to the Brady Urological Institute, May, 1915.

Patient, B. U. I. 4395, aged 12 years, complained of frequency and difficulty of urination since birth. Large, sausage-like masses could be felt on each side of mid-line and beneath the costal-margin; on either side, large, soft structures, apparently kidneys, were palpable, right considerably larger than the left. It was impossible to pass the ordinary catheters and sounds, but a ureteral catheter was introduced without much difficulty and withdrew 700 cubic centimeters of cloudy urine. After the bladder was washed clean, a child's cystoscope, about No. 12F. calibre, was introduced without difficulty. Both ureteral orifices were found markedly dilated and the bladder was trabeculated. The prostatic orifice was found to be dilated. A cystogram was obtained with thorium nitrate, 10 per cent, which showed marked dilatation of the upper part of the prostatic urethra, bladder, both ureters, and kidney pelves, as shown in Figures 3 and 4. On June 2, 1913, suprapubic cystotomy was carried out by Young, and dilatation of the vesical sphincter was discovered. The index finger could be introduced through the internal sphincter and passed down the urethra about 1 centimeter, where it met with an obstructive band across the urethra. A small sound could not be passed through the urethra into the bladder unless the beak was made to hug the posterior wall of the urethra for it met there an obstruction, evidently a band or valve which could be felt from above. By means of the cystoscopic rongeur which was passed through the urinary meatus, this band was cut and excised. The operation was repeated three times. The valve was quite firm, fibrous, and a moderate amount of force was necessary in order to excise it with the rongeur. Examination of patient with finger through suprapubic wound then showed that the urethra was widely dilated and that the finger could be introduced as far as the triangular ligament. A drainage tube was placed in the bladder suprapubically, the wound closed, and an excellent result obtained. He was well for 11 years. He then entered the hospital with perinephric abscess, pulmonary signs, myocardial failure, and death. Drawing of autopsy is shown in Figure 5.

The first case to be recognized at autopsy in America is that of Knox and Sprunt in a report from the Medical and Pathological Departments of Johns Hopkins Hospital.

The patient, a boy aged 5 years, had suffered with frequency of micturition since birth. On examination, he was found to be sparely nourished, with pendulous, distended abdomen. On palpation in the left lumbar region there was made out a soft, movable, lobulated mass from the anterior superior spine to the costal margin and about midway between the umbilicus and lateral portion of the abdomen. This mass could be readily brought between the fingers in bimanual palpation; its borders were rounded. In the right flank a similar mass was made out emerging from the lower border of the liver. A third rounded mass was detected in the midline, extending from the symphysis pubis to the level of the umbilicus, suggesting an enlarged urinary bladder. Urine was turbid and its specific gravity was 1002. The presence of the lobulated tumors above described, in the flanks, made a diagnosis of congenital cystic kidneys possible. "He was admitted to Johns Hopkins Hospital January, 1912, very pale and ill. On palpation a distended bladder and enlarged kidneys on both sides were made out. No urological examination was attempted in the Pediatric Department and patient died at the end of 2 weeks." Autopsy findings are shown in the excellent drawing, Figure 6. "A probe passed through the vesical orifice met obstruction in the lower prostatic portion; similarly, when the urethra was sounded through the external meatus, obstruction was encountered in the same region." The roof of the urethra was divided and the posterior urethra was described as follows: "Through the wide internal meatus the bladder becomes continuous with the greatly dilated and thick walled prostatic urethra which forms an oval sac with the distal, blind extremity 2.5 centimeters from the internal meatus. The floor of this pouch shows several prominent folds near the midline which end below in an unusually prominent verumontanum which reaches three-fifths of the distance from the internal meatus to the blind end of the sac. The opening of the vagina masculina is conspicuous, shaped like a crescent, with the concavity directed upward. Numerous orifices of the prostatic ducts are observed on each side of the verumontanum but those of the ejaculatory ducts are not seen. Immediately below the verumontanum, the ridge, of which it forms a part, divides into two prominent diverging folds which soon fuse with the anterior wall of the urethra instead of fading out gradually on the posterior wall of the urethra as usual. Just below the verumontanum between the diverging folds, there is a small equilateral triangular opening, the sides of which measure about 3 millimeters. A probe passed through from the anterior urethra, presents in this opening and abuts against the hypertrophied verumontanum. This is the only communication between the anterior and posterior portions of the urethra."

Microscopic description: "Sections were prepared from the lower end of the prostatic sac; through the folds immediately below the verumontanum; and through the proximal end of the same structure. The blind end of the prostatic urethra is clothed with stratified pavement epithelium similar to that of the œsophagus. The folds below the verumontanum are covered with the same type of epithelium but that of the anterior urethra is so badly desquamated that its nature cannot be definitely determined. Over the verumontanum and the rest of the prostatic urethra, the usual type of epithelium is present. The subepithelial tissues everywhere consist of a very dense, fibrous tissue with a few elastic elements. Small clusters of mononuclear cells may be found occasionally beneath the epithelium. The vagina masculina is not prominent. Indeed, it is less conspicuous than is often the case."

The third American report was made by Lowsley in 1914. An autopsy upon an infant 3 months old, showed valvular obstruction at the lower end of the verumontanum, bilateral hydronephrosis, and hydro-ureters. In 1919 Young, Frontz, and Baldwin presented the fourth American paper in which they reported 12 cases, in 8 of which operation had been successfully carried out. The four cases in which operation was not performed had died. In the literature at that time they found 17 definite cases, all of which had been found at autopsy. In none of them had diagnosis been made or operation carried out so that the true condition was recognized only at autopsy.

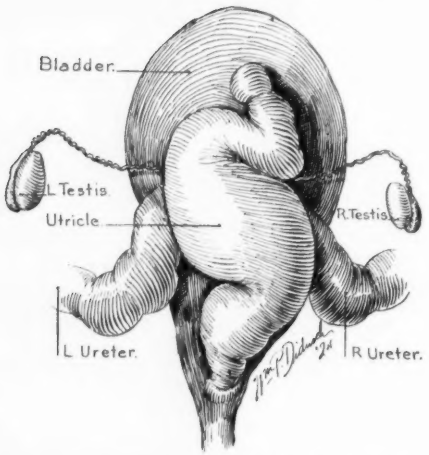

Fig. 1. First illustration published of condition produced by urethral valves. It shows the enormously dilated ureters, a greatly dilated sinus pocularis, a dilated posterior urethra, and a dilated bladder. (Redrawn from Tolmatschew.)

In 1916, Young carried out his punch operation in cases of congenital valves in adults, respectively 26 and 42 years of age, with complete relief of obstruction in both cases.

In 1920, a child, 7 years of age, with a typical case of congenital valves of the posterior urethra, came to Brady Urological Institute and for this case Young constructed a specially small "baby punch."

A large amount of residual urine was drained by a ureteral catheter until phthalein tests showed improved renal function. Cystoscopy was then carried out, by means of a child's cystoscope and a special small urethroscope. The urethroscope brought out plainly the slit-like orifice between the two lateral valves. A special punch, No. 17F. was made for this case (Fig. 7), with which the valves were easily removed in one bite. This instrument was first introduced through the urethra until the inner end was free in the bladder. Then the cutting obturator was withdrawn and fluid began to escape. The instrument was then pulled outward until the valves were caught in the fenestra. The field was dried, and with an endoscope light attached to the outer disk, the valves were easily seen to fill the entire field of the instrument. The inner cutting tube was then reinserted and the valve itself removed in one piece, after which larger instruments could be passed into the bladder with ease.

This method was very satisfactory in the case employed, and it seemed quite feasible to prepare minute "baby punches" which could be used for infants at birth.

In 1921 Randall reported two cases of congenital valves of the prostatic urethra in which he carried out fulguration through a cysto-urethroscope. One of these patients was only five years of age, the other, seventeen. The method was new but apparently entirely successful.

The next important clinical paper was that of Hinman and Kutzman, who, in 1925, gave a very full and comprehensive résumé of the literature. They reported 6 cases, 3 in children between 2 and 4 years of age and 3 in adults. In 4 cases the diagnosis was made by cysto-urethroscopic examination. In 2, by means of cystograms. The treatment employed was suprapubic cystotomy with destruction of the valves in 4 cases, and urethroscopic fulguration in 2 cases. The results were apparently satisfactory in all cases.

Another case in which the valve was recognized cystoscopically was that of Scholz, who subsequently destroyed the congenital obstruction by means of passage of sounds. (See Table III.)

Excluding our reports, we have found 41 cases in the literature, in 12 of which operation on the valves was carried out. We report herewith 21 cases from the Brady Urological Institute, making a total of 62 cases which are tabulated and studied in detail.

In making a critical analysis of the cases mentioned in the literature, we find the following cases of valvular obstruction that we have not counted as true posterior urethral valves. Eigenbrodt, 1891, operated upon an obstructing valve which was intravesical and not in the posterior urethra. Posner in 1907 describes a case that was probably urethral stricture and not true valve formation. Jordan, 1913, also reported a case that was probably urethral stricture and not true valve formation. Iverson, in 1914, reported a case of a man 85 years of age, who had a very large prostatic hypertrophy. False passages were produced in the prostatic urethra from instrumentation, and the stricture which he saw at suprapubic operation from the description was probably an artifact from instrumentation and not a true posterior urethral valve. We have included these 4 cases in the tabulation but subtract them from the total number of 45 tabulated, leaving 41 true cases, in the literature.

The 12 cases shown in Table I comprise the first series of congenital valves of the posterior urethra reported from the Brady Urological Institute. Of these 12 cases, 8 were operated upon; 6 of the 8 operated upon were cured or markedly improved. In 4 cases in the series, operation was not done; all of these with one exception died soon after admission to the hospital. They were *in extremis* on admission. Of the 6 patients operated upon and

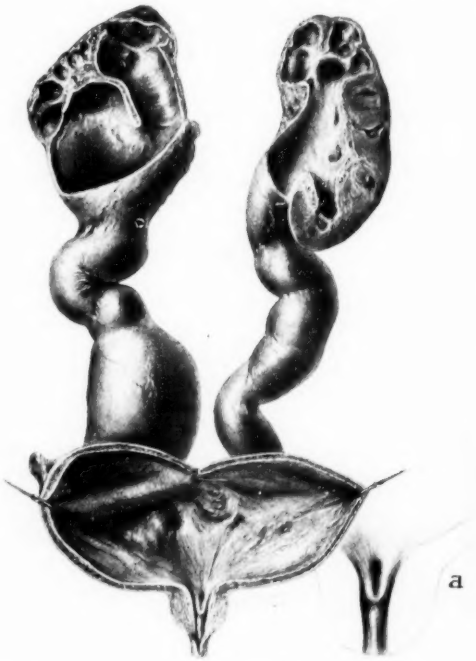

Fig. 2. First case recognized by optical instrument in a living subject shows the remains of congenital obstruction Type 2: dilated bladder, marked hydro-ureter, bilateral hydronephrosis. Valves ruptured instrumentally. In this case, the long examining barrel, used with lithrotrite, was passed up the right ureter all the way to the pelvis of the kidney and a view of the pelvis of the kidney was in this manner obtained. This is also probably the first patient in which the pelvis of the kidney was cystoscoped during life. Insert A shows enlarged view of condition present.

reported as leaving the hospital well, we have traced the following:

Case 1 returned to the hospital after 11 years reporting that he had been quite well since, urination normal. At 21 years began to have intercourse irregularly, and ejaculation was normal. He contracted gonorrhœa 1 month previous to entering hospital, and the infection spread into the bladder and upper urinary tract. At time of admission to the hospital he had a temperature of 101 degrees. His urine was loaded with pus and intracellular diplococci. He also had a very severe throat infection and developed a perirenal abscess which was aspirated and showed streptococcus viridans in culture. His course in the hospital was steadily down-hill. He developed pulmonary symptoms, followed by myocardial failure and died. Autopsy showed cystitis, bilateral pyonephrosis, old Pott's disease of the spine, amyloid spleen, and a large perirenal abscess, cultures from which showed streptococcus viridans. This is the case illustrated in Figures 3, 4, and 5.

Case 10 has been well for 11 years, save for the fact that he has had bilateral nephrolithiasis for which condition he has been operated upon successfully elsewhere.

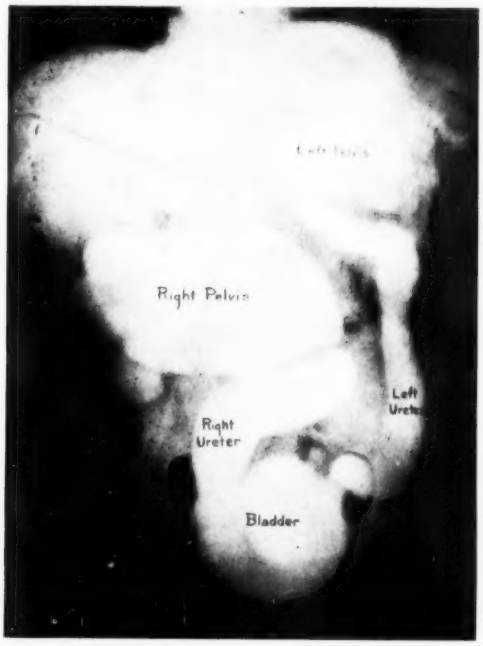

Fig. 3. B. U. I. No. 4395. Cystogram showing distended bladder, dilated prostatic urethra, bilateral hydronephrosis, and hydro-ureter. Suprapubic cystotomy, with destruction of valves.

All attempts to gain contact with the other four cases have proved futile.

Since this report in 1919, we have seen in the Brady Urological Clinic 9 additional cases of congenital valves of the posterior urethra. A detailed description of each case follows.

Case 1. Congenital valves. Punch operation with baby punch. Cure. Followed five years.

B. U. I. 8555, B. G., aged 8 years was admitted to the hospital February 24, 1920, complaining of bladder and stomach trouble. The patient was one of eight children, the rest of whom were living and well. He was a full term child, of a normal labor, and was breast fed. The mother had noticed that the child passed urine very frequently. Apparently at night he urinated every few minutes, wetting the bed. She noted also that sometimes during the day he wet his clothes and complained of severe dysuria at times. It was noted when the child was quite young that he had a large distended abdomen. There had been no history of complete retention, no periods of inability to urinate. His mother had noticed that the child had always had a bad color and had been rather sallow. He had never gained in weight in proportion to his age. The condition had been diagnosed by a doctor as enuresis.

Physical examination showed hæmoglobin 88 per cent; white blood cells, 11,000; red blood cells, 4,500,000. Examination showed a well developed boy except for the protuberant abdomen. The teeth were in very poor condition.

Fig. 4. Cystogram showing side view of case shown in Figure 3. Note dilatation of posterior urethra, dilated right ureter, and right renal pelvis.

The abdomen was found to be distended, the muscles being held tense. No tenderness was present on palpation. Bladder could be palpated on percussion up to the umbilicus. Rectal examination showed anal sphincter of good tone. The prostate was distinctly palpable and was of about normal size for a boy of his age, but was somewhat firmer than normal. No irregularities were made out. Membranous urethra was negative. Triangular ligament and bulb felt normal. Nothing suggesting congenital valve was palpable per rectum. A No. 14 catheter was easily passed into the bladder and 300 cubic centimeters of urine recovered from the bladder. This fluid was replaced again at the end of examination. A No. 14 sound met with obstruction in the anterior part of the prostatic urethra, but was finally passed. A small child's cystoscope was passed following the sound. Study of the bladder showed normal trigone and ureteral orifices, slight trabeculation, apparently no cystitis present, no stones, no cellules, or diverticula. Study of the prostatic orifice showed that it was dilated forming a common cavity with the bladder. There was no median bar or contracture of the vesical orifice. When the child's cystoscope was drawn out into the urethra, it was possible to view the floor of the urethra, which was described as being "fan-shaped." Running downward from the prostatic orifice anteriorly, there was a fold which, when viewed from the side, appeared to be a valve or diaphragm. It was impossible to get a view of the verumontanum, because when the cystoscope was pulled down to its vicinity the region was obscured by the valve.

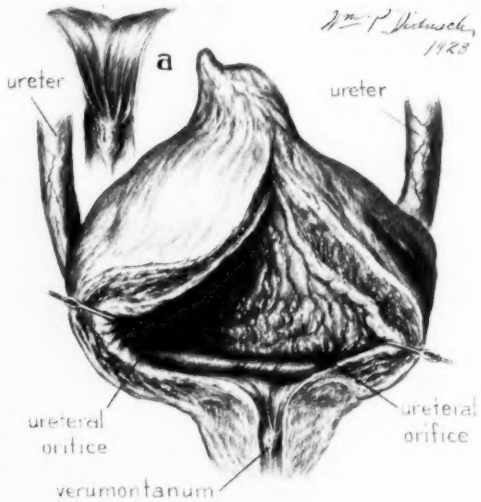

Fig. 5. B. U. I. No. 4395. Shows condition present 11 years after destruction of valves with cystotomy and cystoscopic rongeur. Patient died of myocardial failure. Drawing of autopsy specimen shows posterior urethra, dilated ureteral orifices, and hydro-ureter. Valve destroyed. An enlarged view of condition of posterior urethra is shown in insert A.

A small tubular endoscope (No. 17F. in size), which had been made especially for this case, was then introduced. This passed into the bladder without difficulty. The endoscope was then withdrawn slightly and showed a dilated internal sphincter. As the instrument was gradually withdrawn into the prostatic urethra, a valve with an irregular edge was seen on either side of the verumontanum, which was plainly visible through the endoscope, but not through the cystoscope. As the instrument was entirely withdrawn, the valves were seen to come together, leaving a small irregular slit, the edges of which were roughened, red mucous membrane. The urine was cloudy; acid; specific gravity 1030; no albumin; few pus cells and bacilli. Cystogram was taken and showed a dilated asymmetrical bladder with funnel-shaped dilated prostatic urethra so commonly seen in congenital valves. There was no regurgitation of iodide up the ureters. The punch operation was done by Young, nitrous oxide gas-ether anæsthesia being used. One cut was made and a valve was removed from the prostatic urethra and a small part of the verumontanum with valve. There was a very small amount of hæmorrhage. No retained catheter was used.

A punch instrument, No. 17F., similar to Young's adult punch, was introduced into the bladder with the cutting obturator in place. The obturator was then withdrawn and the fluid from the bladder allowed to escape. The bladder was refilled with fluid and an endoscopic light was attached to the end of the punch instrument. It was seen by means of this device that the fenestra of the instrument lay in the prostatic urethra. It was turned slightly to the left with the idea of excising the valve on the right side of the urethra. It was found, however, that the instrument was firmly grasped, and investigation showed with the endoscopic light that a mass of mucous membrane was caught in

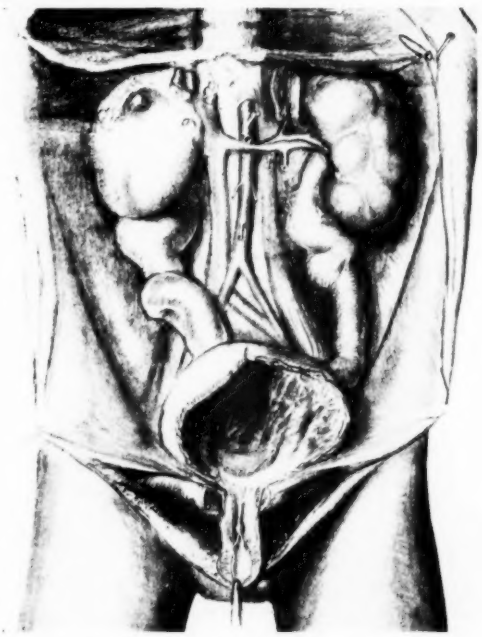

Fig. 6. Case of Knox and Sprunt, showing typical urethral valve of Type 1 with the usual back pressure effects produced.

the fenestra of the instrument. By the sliding home of the cutting obturator, this entrapped mucous membrane was divided, and when removed with the instrument, it was found to consist of a portion of the right valve and a small piece of the verumontanum. The strip of mucous membrane removed was approximately 1 centimeter long and about 4 millimeters wide. No catheter was placed in the bladder. No other cut was made.

Postoperative notes: On returning to the ward, the patient voided some urine with small amount of blood. Two days later he was able to hold his urine 3 hours and 50 minutes, voided four times during the day, and held his urine from 8 p.m. to 6 a.m. The size and force of the stream were very good; no hesitation, no straining, bladder not percussible. On discharge, 5 days after operation, the bladder was not palpable above the symphysis. He was voiding three to four times during the day and holding his urine

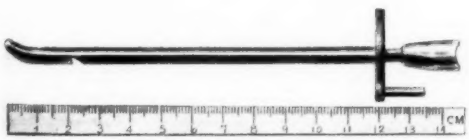

Fig. 7. Baby punch instrument specially designed to remove valves of the posterior urethra in children.

Fig. 8. Case 3. B. U. I. No. 9023. Greatly dilated bladder and huge prostatic urethra,treated by suprapubic cystotomy, rupture of valve with sound and later punch operation.

Fig. 9. Case 5. B. U. I. No. 12427. Cystogram shows large hour-glass bladder with trabeculation. Arrow points to suggestion of dilated prostatic urethra.

Fig. 10. Case 6. B. U. I. No. 15354. Cystogram shows large asymmetrical bladder with very distinct dilatation of posterior urethra from valvular obstruction. Cured by punch operation. Distended ureters and kidneys could be palpated but no regurgitation in X-ray. Probably due to its being taken quite a while after decompression of distended bladder.

Fig. 11. Case 8. B. U. I. No. 16633. Cystogram showing marked dilated bladder rising high above pelvis. Definite funnel at lower end corresponding to prostatic urethra. Valves previously ruptured by passage of instrument.

Fig. 12. Case 9. B. U. I. No. 16577. Cystogram taken 4 days after insertion of catheter shows enormously distended bladder, bilateral hydro-ureters and hydronephrosis, with a great kinking and tortuosity of the ureters. It is interesting to compare this cystogram with Figure 13 which was taken after operation.

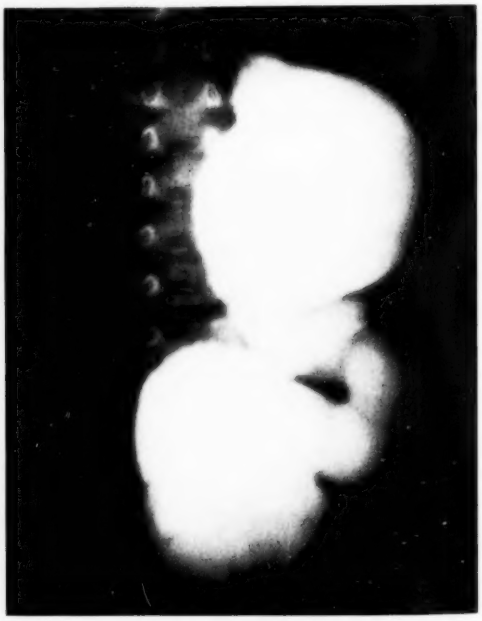

Fig. 13. Case 9. B. U. I. No. 16577. Cystogram taken 12 days after operation and after decompression of bladder and upper urinary tract. Even with great distention no iodide could be forced up the right side.

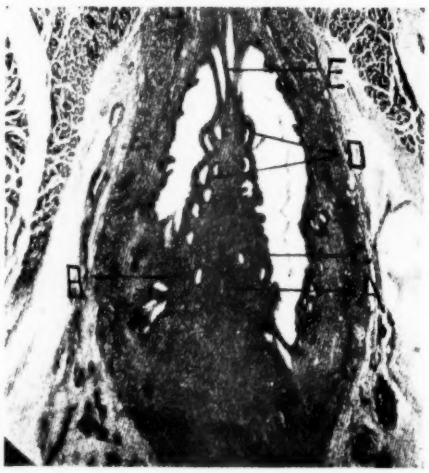

Fig. 14. Cross section of urethra in embryo showing three fibrous bands extending from verumontanum to roof of posterior urethra, illustrating formation of valves. (Watson.)

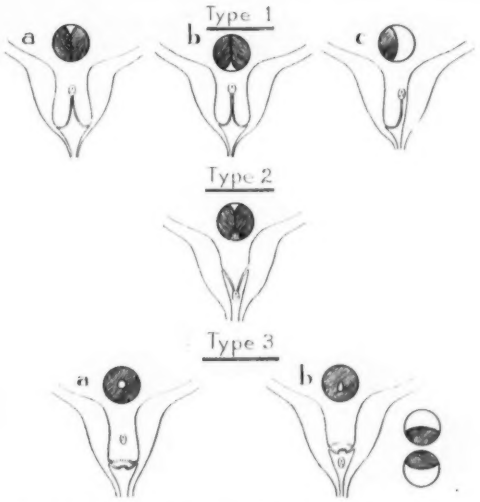

Fig. 15. A diagram showing the three types of congenital valves of the posterior urethra. Type 1: a, Two bifurcated valves springing from distal portion of verumontanum. b, Two fused valves in same position. c, A unilateral valve in same position. Type 2: A bifurcated valve extending from proximal portion of verumontanum to lateral sides of prostatic urethra and roof. Type 3: a, Iris valve below verumontanum. b, Iris valve above verumontanum. The shaded circles represent the cystoscopic field seen in the region of valve. The internal sphincter and the prostatic urethra are shown to be dilated and the region of the membranous urethra is indicated.

all night; had no straining and no hæmaturia. The urine on discharge was clear and showed no infection.

A follow-up of the child showed that 5 years later he was in school, apparently well; he was voiding twice at night, "about a pint at a time." He could not be persuaded to return to the clinic for further examination.

CASE 2. Congenital valves of iris type, treated by suprapubic cystostomy and punch operation. Excellent result.

B. U. I. 8728, R. V. E., 7 years old. Patient was admitted to the clinic with complaint of "unable to hold his urine." General health in the past has been excellent. He has had the usual childhood diseases. Circumcision was done because of enuresis at age of 3. He gives history of incontinence, hesitancy, dribbling, no hæmaturia, renal colic or passage of calculi; some dysuria. Nightly incontinence; diminution in size of stream.

Physical examination showed a fairly well nourished boy of 7 years. Heart and lungs were normal. The abdomen was negative. The left testicle was undescended, the right testicle, normal. Phthalein, appearance time 7 minutes; 40 per cent first hour, 10 per cent second hour—total 50 per cent. Examination: (Frontz) A coudé catheter passed with ease, residual urine 200 cubic centimeters. Cystogram was taken which showed a rather unusual bladder outline. The bladder was roughly oval, long diameter, not in midline but asymmetrical; marked dilatation of the vesical orifice forming a funnel shaped end to the cystogram. Cystoscopy showed marked trabeculæ, cellules, hypertrophy of the trigone, and ureteral ridges. When the child's cystoscope was withdrawn into the posterior urethra there appeared to be a large verumontanum, on either side of which folds of mucous membrane connected with the lateral walls of the prostatic urethra, representing the remains of the ruptured valves were seen.

April 30, 1920, operation was done by Frontz, nitrous oxide-ether anæsthesia being used. Through a suprapubic cystotomy with punch the congenital urethral valve was removed. The bladder was exposed in the usual manner and opened. Examination of the vesical orifice showed

Fig. 16. Sketch of one of former cases showing the crescentic type of valve, Type 3, and hypertrophied bladder and dilated ureters produced by the obstruction.

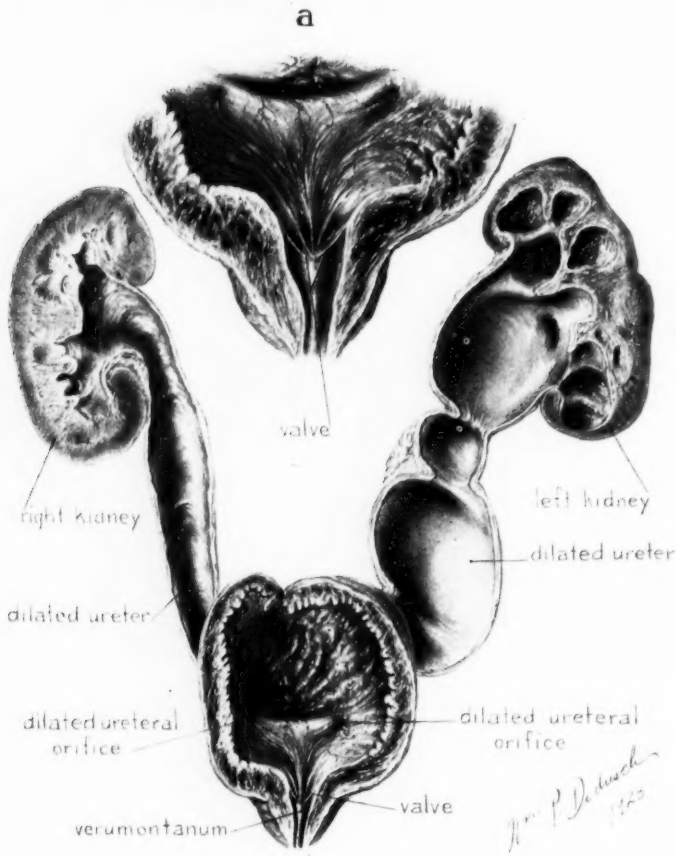

Fig. 17. B. U. I. No. 13248. Patient entered hospital *in extremis* and died shortly afterward. Drawing of autopsy specimen, showing congenital valves of posterior urethra, Type 2. Note the dilated ureteral orifices, hydro-ureters with partial destruction of kidneys. Insert A shows enlarged view of posterior urethra and valve formation. The valves originate at the proximal end of the verumontanum and are attached laterally to the side and anteriorly to the roof of the prostatic urethra. As shown, there is great dilatation of the vesical orifice.

marked dilatation. A finger could be introduced into the urethra apparently as far as the triangular ligament, at which point an "iris valve" was found. The opening in the valve was very small, not exceeding ¼ centimeter in diameter. The baby punch was introduced through the penis and several cuts were made under direct vision thus destroying the valves, after which large sounds were passed through the bladder. The suprapubic wound was partially closed and the bladder drained through a tube.

Convalescence was uneventful. Twenty-eight days after operation the suprapubic wound closed and the patient voided normally, with no dribbling, no incontinence, hesitation or dysuria; size and force of stream, good; interval 2 hours; no enuresis. He was discharged from the hospital well, with a very excellent result.

Case 3. Congenital valves, with great dilation of prostatic urethra, and tight vesical sphincter. Suprapubic rupture of valves unsuccessful; later punch operation.

B. U. I. 9023, L. S., aged 10 years; admitted August 17, 1920, complaining of nocturnal incontinence since birth. Urination has always been difficult. He has had periodic attacks of chills and high fever, associated with severe pain in the back; frequent headache, some vertigo. The patient wore a rubber urinal continuously.

Physical examination showed a fairly well developed, but decidedly undernourished boy. The skin was pale. Ex-

Fig. 18. Cystogram showing large oval distended bladder; arrows point to dilated prostatic urethra and vesical orifice.

amination of heart and lungs showed a lesion in apex of the left lung. The abdomen was negative except that bladder was percussible above the suprapubic region and was distinctly distended. Great obstruction was encountered in the prostatic urethra to the passage of instrument; finally, however, a very small catheter was passed into the bladder and 550 cubic centimeters of residual urine was found. The urine was cloudy; acid; specific gravity 1008; albumin —, pus —, bacillary infection. Hæmoglobin was 83 per cent; blood urea 0.60 grams per liter; phthalein, trace in 2 hours. A cystogram was taken and showed a large dilated bladder with great dilatation of the posterior urethra (Fig. 8).

August 30, 1920, operation was done by Geraghty, nitrous oxide gas anæsthesia being used. Through a suprapubic cystotomy, dilatation of the internal sphincter was done; and congenital valves ruptured by means of large sounds passed retrograde through the prostatic urethra. The bladder was opened and urine was found to be under great pressure. A finger was introduced with difficulty into the vesical orifice and the internal sphincter was found intact. After digital dilation of the internal sphincter, the finger was passed into the prostatic urethra, which was found to be enormously dilated. A large No. 28 sound was passed retrograde through the internal sphincter as far as the bulb.

Several sounds were passed in order to insure breaking up of the valves. A drainage tube was sewed into the bladder suprapubically and the rest of the wound was closed.

Fig. 19. Cystogram shows irregular dilated bladder with trabeculation. No ureteral regurgitation. Arrow points to marked relaxed vesical orifice.

Fig. 20. Cystogram showing marked cellules, a very irregular bladder with a greatly dilated prostatic orifice.

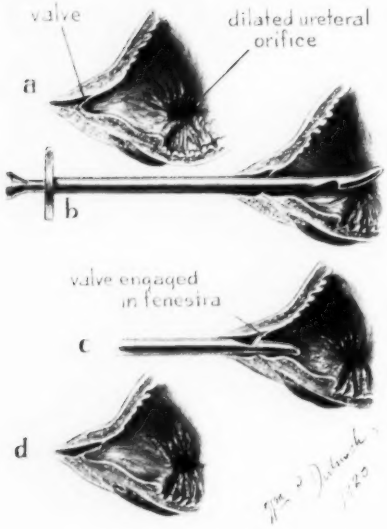

Fig. 21. Diagram of method of removing valves of posterior urethra by means of baby punch instrument. a, Longitudinal section of prostate and bladder showing valve *in situ*. b, Punch in bladder, obturator withdrawn. c, Valve caught in fenestra. d, Prostatic urethra after removal of valve.

Postoperative notes: Very little bleeding was present after operation. Patient voided through the urethra 12 days after operation. The prostatic urethra was kept dilated by the passage of sounds and instillations of mercurochrome forced into bladder. On discharge he was voiding several times daily and had a good forceful stream. At this time the urine showed only an occasional pus cell and only an occasional bacillus.

The boy returned 4 months later because of persistence of the suprapubic fistula. Examination showed residual urine 300 cubic centimeters, although voiding 250 cubic centimeters of urine at a time with ease; phthalein still less than 10 per cent in 2 hours. The urine was cloudy; acid; specific gravity 1005; pus bacilli and cocci. It was decided that because the suprapubic incision had not healed there was still present an obstruction in the prostatic urethra so that Young's punch was passed by Dr. Geraghty and the valves removed by the punch operation. The tissue removed weighed 1 gram, and consisted of two pieces of thin mucous membrane. He was discharged January 31, 1921, voiding several times daily, with good stream and considerable force. He was still passing a small amount of urine through suprapubic fistula.

A month later, the patient returned, greatly improved, voiding freely. The fistula had healed. A catheter found no residual urine. There was no obstruction or stricture, but large sounds were passed and the patient left much improved. We have been unable to obtain further information concerning this patient.

Case 4. Congenital valves attached to verumontanum. Difficult, painful urination. Incontinence. Punch operation. Result, urination free. Dribbling still present.

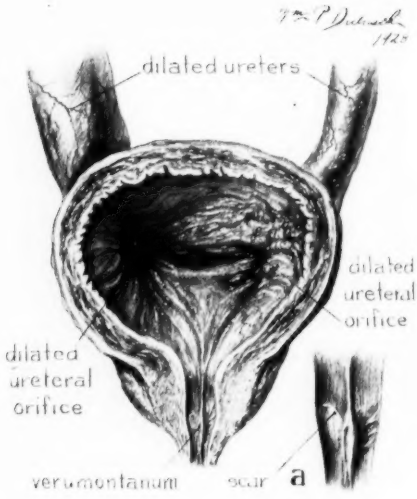

Fig. 22. Drawing of autopsy specimen. The prostatic urethra and bladder are shown after the obstructing valve had been removed. Note the dilated ureteral orifices and hydro-ureters. Scar in prostatic urethra designates former position of valve. a, Enlarged view of scar.

B. U. I. 10155, F. J. P., aged 9, admitted to hospital in June, 1921, complaining of dribbling of urination which had been present since admission. A diagnosis of enuresis was made by his family physician, a circumcision was done and he was put on atropin. He had frequency of every half hour during the day and once at night. His urine frequently dribbled out without his being conscious of it. There was much straining on urination and occasionally he had attacks of pain over the bladder region.

Physical examination disclosed a thorax rather feminine in type, abdomen normal in appearance, hips broad, right inguinal scar of hernia operation. Temperature was 98 degrees; pulse, 100. White blood cells, 17,600; hæmoglobin 80 per cent. The genitalia were very small. Patient voided a fairly good stream but with some hesitation. Prostate and vesicles could not be made out by rectum. Urinalysis revealed specific gravity, 1010; no pus, no infection. Cystoscopy by Young showed a very small, urethral meatus, dilated with sounds to 24F. A child's cystoscope was passed and met with obstruction in the middle of the prostatic urethra, but after considerable manipulation it passed into the bladder. Cystoscope revealed a fairly normal bladder, ureters normal, trigone not hypertrophied, no cellules or diverticula, prostatic orifice widely dilated. When the cystoscope was withdrawn into the posterior urethra, one saw a prominent ridge, which was probably the posterior surface of the verumontanum, and on either side of this a deep pouch. At the lower end extending downward on either side of verumontanum was a definite ridge with a sharp edge. These were definitely valves of the posterior urethra. On withdrawing the instrument to a point just in front of the verumontanum, one saw a small cleft between the valves, probably the communication between the anterior and posterior portions of the prostatic urethra.

December 7, 1921, the punch operation was done by Young, ether anæsthesia being used. Congenital valves of

posterior urethra were excised, two large pieces of valve being removed. Five cuts were made. The first cut was directed posteriorly, the valve caught in fenestra, and the cutting tube pushed home. A little mucous membrane was found in the instrument. A second cut was made again posteriorly, then one slightly to the right and one to the left. The instrument was then turned anteriorly and slightly to the left, and a considerable amount of tissue was removed when the knife was pushed home. Altogether five cuts were made, but only two succeeded in excising much tissue. Following this, a No. 22 sound passed into the bladder with ease. A No. 16 catheter was left in the bladder.

Postoperative notes: Patient was discharged 10 days after operation, voiding urine with good stream and passing as much as 60 cubic centimeters at one time. When his attention was directed to his bladder he was able to retain urine. At other times, when attention waned, he wet clothing and bed. His bladder capacity on forced distention was only 60 cubic centimeters. Before he left the hospital a No. 22 sound could be passed into bladder without difficulty. He was discharged from the hospital with instructions to retain urine as long as possible, in the hope of thus dilating the contracted bladder. The child was poorly trained, but when he made conscious effort he could retain urine for 2 or 3 hours. It seems probable that too many cuts were made thus producing incontinence. Two years later the child was reported as passing 8 ounces of urine at a time but still refused to make conscious effort to hold his urine, and further follow-up of child was unsuccessful.

CASE 5. Congenital valves. Incontinence. Valves ruptured by sounds before admission. Streptococcus infection, pyonephrosis, impetigo, death, no operation.

B. U. I. 12427, H. R. H. 15 years old, was admitted June 24, 1924, with complaint of frequency and hæmaturia. There had always been some frequency and nycturia without pain, and nocturnal incontinence for one year. Hæmaturia appeared 1 week before admission.

Physical examination disclosed a poorly developed, undernourished boy, with tremor of fingers, slight cyanosis, rhinitis, and cardiac enlargement. Pulse, 120; respirations, 23; blood pressure 130–74; white blood cells, 18,000; red blood cells, 4,000,000; hæmoglobin, 55 per cent. A diagnosis of chronic rheumatic endocarditis and mitral insufficiency had been made. Bladder was percussible above the symphysis. Both kidneys were palpable. There was slight tenderness in both flanks. Rectal examination disclosed prostate normal in size, shape, and consistence. Patient was cystoscoped and 260 cubic centimeters of residual urine was found. The bladder capacity was 325 cubic centimeters. The bladder showed trabeculation, no ulcers, no diverticula. The trigone was slightly hypertrophied. A study of the prostatic orifice showed an internal sphincter so greatly dilated, that the cystoscope could be pulled out into the posterior urethra and the verumontanum seen. As one drew the cystoscope out to the region of the verumontanum, floating tags of mucous membrane were seen projecting from the lateral walls of the posterior urethra. These were assumed to be ruptured valves. A cystogram showed a dilatation of the vesical sphincter, a large, hourglass bladder, with some trabeculation (Fig. 9).

Urinalysis disclosed cloudy, acid urine; specific gravity, 1004; albumin, 3 plus; occasional casts, pus 2 plus; culture of pus showed bacilli and cocci. Phthalein test showed on admission: appearance time 12 minutes, 45 per cent 1 hour. After admission patient became quite sick. He had a fluctuating temperature up to 103.8 degrees. Pulse went as high as 130, hæmoglobin dropped to 42 per cent. Blood culture was negative. A type of impetigo with herpetic vesicles from which streptococci were cultured developed. He was given a blood transfusion, and this was followed by a marked reaction, with considerable drop in blood pressure and acute dilatation of the stomach. The non-protein nitrogen rose to 200 milligrams per 100 cubic centimeters. Temperature rose and remained around 103. Patient died July 7th. Autopsy (No. 8131 J. H. H.) showed congenital valves of posterior urethra, dilatation of the bladder, cystitis, urethritis, bilateral pyelonephritis, bilateral hydronephrosis, with hydro-ureter, double left ureter, with double kidney, dilatation of stomach, hyperæmia of intestines, enlarged heart.

The fatal ending in this case should be taken as a warning not to rupture the congenital valves by the passage of sounds, without previous preparatory treatment directed against the renal impairment and residual urine.

CASE 6. Congenital valves of the prostatic urethra; obstruction but no incontinence; kidneys, ureters, and bladder markedly dilated; punch operation; cured. Followed 18 months. Well.

B. U. I. 15354, R. A., aged 11 years, admitted to hospital, October 23, 1926. Patient has had difficulty of urination since birth. Shortly after birth the abdomen was discovered to be much enlarged. This continued up to the time of admission. There was also a history of occasional headaches and the usual diseases of childhood but no persistent incontinence or impaired health. The present illness began with vomiting 2 months before admission, which was followed by nausea and frequent drowsiness. Examination by patient's physician revealed bilateral tumors in the kidney region, and a diagnosis of congenital polycystic kidney was made. Two weeks before admission the non-protein nitrogen was 98 milligrams per 100 cubic centimeters. On admission, examination revealed a distended abdomen, chronic nausea, occasional vomiting, difficulty of urination, but no incontinence. The face was œdematous, pulse 80, chest normal, both kidneys enlarged and palpable two to three fingers' breadth below the costal margin. The dilated ureters were palpable on each side of the median line from the kidneys to the bladder. On rectal examination the anal sphincter was found to be normal, the prostate underdeveloped, the base of the distended bladder greatly dilated, and the ureters palpable by rectum. The bladder was greatly dilated. On October 29th, a No. 16 coudé catheter was passed with ease until the prostatic portion of the urethra was reached. It then encountered an impassable obstruction. After much manipulation a No. 7 ureteral catheter passed into the bladder. The urine was allowed to escape gradually over a period of 3 days, at the end of which time the palpable distended bladder, ureters, and kidneys had disappeared. The urine was clear; acid; specific gravity, 1006; albumin plus; microscopic examination negative. Blood creatinine was 12 milligrams per 10 cubic centimeters, non-protein nitrogen was 160 milligrams; carbon dioxide, 27.7 per cent. There was no excretion of phthalein in 3 hours. Three days later the blood urea dropped from 160 to 110 milligrams, and the phthalein rose to 16 per cent in 2 hours. During the next 10 days, the bladder was drained continuously with a ureteral catheter, and during this period the blood urea dropped to 37 milligrams and the phthalein increased to 16 per cent in 3 hours. The patient improved immensely in general health and was considered sufficiently well for operation. A cystogram was taken 10 days after urethral instrumentation. As seen in Figure 10 there was a greatly distended bladder which extended upward to the brim of the pelvis on the right. There was a conical process extending from the bladder down into the posterior urethra to the

point of valvular obstruction. There was no reflux into either ureter. It is probable that if the cystogram had been taken when instruments were first used, the dilated ureteral orifices and reflux into the kidneys would have been shown.

January 9, 1927, operation was done by Dr. Frontz. No anæsthesia was used. The Young's baby punch was introduced into the urethra and was arrested in the region of the valves, but after some manipulation, was passed into the bladder. The cutting tube was partially withdrawn. The urine escaped when the outer tube was drawn outward. The instrument was turned so that the fenestra was directed toward the right and withdrawn until the instrument was arrested. It was thought that the right valve had caught in the fenestra of the instrument. The inner cutting tube was then quickly pushed home and the instrument withdrawn. The operation caused little or no pain or hæmorrhage. A No. 12 soft rubber catheter was then easily introduced into the bladder and left in place.

The patient reacted well and improved rapidly, but on account of the anæmic condition, 10 days after operation, a transfusion of 500 cubic centimeters of citrated blood was given with slight reaction. Eleven days after the operation the non-protein nitrogen had fallen to 37 milligrams and the creatinine to 1.5 milligrams per 100 cubic centimeters. The carbon dioxide had risen to 61.3 volumes per cent. The catheter was then removed and the patient voided naturally without hesitation and had no incontinence. On discharge the urinary stream was large and forcible, and the condition of the patient was excellent. The patient has been followed about 1½ years. His health is excellent and micturition is normal.

Case 7. Congenital valves of prostatic urethra; greatly distended bladder and kidneys. No phthalein output; high non-protein nitrogen; chronic uræmia. Catheter drainage; continuation of uræmia and death. No operation.

J. W., B. U. I. 13248, aged 2 years, 9 months, admitted to the Johns Hopkins Hospital February 13, 1925, complaining of difficult and painful urination, and tumor of abdomen. The child was in good condition at birth. Shortly afterward the mother noticed the child had a poor appetite and vomited frequently. This continued up to the time of admission. The child also had a history of attacks of pain in the abdomen which was continually distended. There was marked constipation, difficulty and frequency of urination, and considerable straining. Between voidings there was incontinence, and the clothing was constantly wet. He was seen by a physician who made a diagnosis of tuberculous peritonitis because of the palpable masses in the abdomen. On admission the patient had marked frequency and difficulty of urination, associated with a distended abdomen and pain. Examination revealed an undernourished and underweight child, who was unable to walk alone. Chest was negative. The abdomen was very prominent and spherical, with marked dilatation of superficial vessels. Palpation disclosed a greatly dilated ureter on either side, and both kidneys were enlarged and palpable a considerable distance below the costal margin. The bladder was distended, reaching halfway between the umbilicus and symphysis. A rectal examination was not made. A No. 10F. soft rubber catheter, arrested in the prostatic urethra, after some manipulation, finally passed into the bladder. Care was taken not to empty the bladder. A catheter was connected with the Young-Shaw decompression apparatus. The non-protein nitrogen taken the day after the insertion of the catheter showed 113 milligrams per 100 cubic centimeters. The phthalein test showed no excretion in 2 hours. Examination of the urine 24 hours later showed no trace of phthalein. The decompression was completed within 24 hours, after which free drainage was continued through a catheter for 11 days. Eight days after the institution of the catheter drainage, phthalein had risen to 5 per cent, and the child was improved, but a few days later began to get progressively worse. The non-protein nitrogen rose to 137 milligrams per 100 cubic centimeters, the nausea, vomiting, drowsiness, and uræmia continued. Patient finally died 11 days after the catheterization.

This patient was in a desperate condition on admission, with no phthalein output and a non-protein nitrogen of 113. Had decompression been maintained longer than 24 hours, it is possible that the patient would have done better. However, the condition was almost hopeless from the start.

Case 8. Congenital valves of the prostatic urethra, moderate obstruction. Good health, and renal function maintained. Cured by instrumental rupture of valves.

B. U. I. 16633, aged 7½ years, admitted to hospital October 14, 1927, complaining of dysuria and pyuria. History of long-continued frequency of urination night and day. The patient had recently had burning and pain on urination. One year ago he had chills and fever, associated with cloudy urine. On admission urination was free, but painful, and stream was good. There was no hesitation. The pain started in the deep urethra and radiated to the end of the penis. There was no history of hæmaturia. Urination was frequently intermittent, accompanied with sudden stoppage with the advent of pain, and then when the pain disappeared, there was no passage of urine. There was no pain in the region of either kidney, but the bladder pain frequently radiated to the region of the umbilicus. There was a history of nausea and vomiting and gas. Seventeen days before admission he was cystoscoped elsewhere, and a dilatation of both ureteral orifices and ureters was made out. The X-rays (plain and stereoscopic) which patient brought with him showed both ureters and kidney pelves greatly dilated. Examination disclosed the chest normal and abdomen negative. No abdominal masses were made out. The urine was cloudy, acid; specific gravity, 1006; albumin plus; pus, 2 plus; cocci and bacilli. The non-protein nitrogen was 63 milligrams per 100 cubic centimeters; creatinine 2.6 milligrams per 100 cubic centimeters. Temperature was 99.6 degrees; pulse, 100; hæmoglobin, 84 per cent; white blood cells, 15,000. A small rubber catheter could be passed with ease; no obstruction was encountered; 150 cubic centimeters residual urine was withdrawn. A cystogram was taken with 12.5 per cent sodium iodide (200 cubic centimeters). Figure 11 reveals a markedly dilated bladder, rising high above the pelvis, no reflux into the ureters, definite funnel at the vesical neck. October 18, 1927, cystoscopy was done by Young. A child's cystoscope entered with ease. Trigone was not hypertrophied. Ureteral ridges were not enlarged. Both ureteral orifices were markedly dilated. The bladder was not trabeculated. The prostatic orifice was dilated. When the instrument was drawn out into the urethra, a thin strip of mucous membrane which was attached to the wall of the urethra and hung free in the lumen was visible on each side, probably valves of the verumontanum which had been ruptured by previous instrumentation. When the cystoscope was withdrawn still farther, another thin strip of mucous membrane was forced across the field of vision. It was attached to the roof of the urethra, probably a portion of the valve attached to the verumontanum. On admission the phthalein appeared in 9 minutes; first half-hour, 25 per cent, second half-hour 20 per cent, third half-hour, 15 per cent, fourth half-hour, 5 per cent, last 9 minutes 5 per cent, total 70 per

cent, in 2 hours after appearance. Subsequent examination showed a similar high out-put. The non-protein nitrogen varied from 40 to 48 milligrams per liter. Treatment consisted of passing sounds at intervals of from 3 to 4 days, with continuous drainage of bladder, with an inlying catheter, followed by an irregular passage of sounds up to No. 26F. at intervals of from 2 to 4 days. This was followed by a rapid improvement in urination. On discharge from the hospital the patient was able to void in a good stream without hesitation. Control was good and there was no incontinence.

CASE 9. Congenital valves of the prostatic urethra; marked obstruction with great dilatation of kidneys and ureters; impaired renal function; punch operation; one valve excised; obstruction removed; dilatation of one ureter and kidney.

J. W., B. U. I. 16577, aged 4 years, admitted to Harriet Lane Home of the Johns Hopkins Hospital, September 14, 1927, complaining of "large stomach," pain on urination, and frequent vomiting since childhood. The patient had not gained in weight. He was generally constipated; has had numerous respiratory complications; and bad health since infancy. Stream is very difficult to start, is accompanied by severe straining and much pain. Occasionally there were a few drops of blood at the end of urination. Examination (McKay) the chest was negative and the abdomen enlarged in the suprapubic region and in both flanks. No free fluid was demonstrated in the abdomen. The bladder was dilated and palpable up to the umbilicus. Above it a sausage-shaped mass was palpable on each side, presumably dilated ureters. Both kidneys were enlarged and palpable three fingers' breadth below the costal margin. Pressure on the bladder caused a desire to void and also produced much pain. The genitalia were normal. On rectal examination the prostate was normal. The base of bladder was palpable. The ureters were not made out. The patient was able to pass only 30 cubic centimeters of turbid urine at first voiding. Two minutes later he voided 60 cubic centimeters more, and again after a few minutes a like amount. A catheter met with definite obstruction in the prostatic urethra. After considerable manipulation, a No. 7 olive tipped urethral catheter was passed into the bladder, and fluid allowed to escape slowly. The blood urea on admission was 0.44 grams per liter. Phthalein appeared in 40 minutes, but there was no elimination during the first and second half hours. There was 4 per cent at the end of the third half-hour; fourth half-hour, 8 per cent, last 40 minutes, 10 per cent, total 20 per cent, in the 2 hours after appearance. Urine was acid; specific gravity, 1006; albumin, plus; pus, plus; bacilli present. Four days after the insertion of a urethral catheter a cystogram was taken. As shown in Figure 12 there was dilatation of the bladder, both ureters and kidney pelvis, with great tortuosity of the dilated ureter. No funnel shaped projection into the prostatic urethra is seen. Cystoscopy was done (McKay). A No. 17 child's cystoscope passed easily. The bladder was trabeculated, the ureteral orifices greatly dilated, and the trigone hypertrophied. No diverticula or cellules were seen. The prostatic orifice was greatly dilated. Drawing the cystoscope into the prostatic urethra, and turning to one side, a typical congenital valve of Type I was seen on the opposite side. The valves extended from the inferior portion of the verumontanum outward to the lateral walls of the bladder and downward along the roof. Near the apex of the prostate, one was able to see the point of fusion of the two valves above. September 27, 1927, a punch operation was done by Young and McKay. No anæsthesia was used. The baby punch was easily introduced into the bladder, turned to the left, inner cutting tube partly withdrawn, followed by escape of fluid. The instrument was then drawn out until arrested, evidently by a left valve leaflet. The inner cutting tube was rapidly pushed home, excising a leaflet which, when spread out, measured 3 millimeters in diameter. It was thin and membranous in character. The patient was removed immediately from the table and voided 150 cubic centimeters of urine freely in a large stream. After waiting 5 minutes 100 cubic centimeters more urine was voided, probably due to the filling of the bladder by the overdistended ureters and kidneys. A second cystogram taken 12 days after the operation showed no reflux into the right ureter. The left ureter and kidney pelvis were still greatly dilated. Since then repeated cystograms have been taken on several occasions, and continued to show no reflux into the right side but persistent distention of the left ureter and kidney pelvis, as shown in Figure 13. No inlying catheter was employed after the operation. Micturition was normal. The urine was cloudy with pus and bacteria present. The phthalein output increased during the first half hour from 10 to 27 per cent. The blood urea rose from 40 to 75 milligrams per liter. The patient was discharged from the hospital 25 days after admission in excellent condition, voiding naturally with no hesitation and no incontinence. He has been followed practically 7 months. He has improved greatly in health and strength. His weight has increased 4 pounds. Micturition is normal, but his urine is still cloudy.

Although the urinary obstruction has been completely relieved by the removal of one valve with the punch, and although reflux into one ureter has ceased, reflux into the other kidney still persists and shows great distention of the ureter and kidney pelvis. However, there has been marked improvement in health, gain in weight, and activity of the child.

Of the 9 cases reported in Table II seen in the Brady Urological Institute since 1919 the ages of the patients were:

Age in years	Cases
0 to 5	2
5 to 10	4
10 to 15	3

METHOD OF TREATMENT AND RESULTS

Punch operation, all cured of obstruction	5
Suprapubic cystotomy with destruction of valve by punch, cured	1
Suprapubic cystotomy with unsuccessful retrograde sounding; punch operation at later date; cured	1
Rupture of valve by sound, before admission, septicæmia, death	1
Not operated upon, *in extremis* when entering hospital, death	1

RESULTS OF CASES TREATED

Cured	6
Cured of obstruction but incontinent	1
Not treated, died	2

These results show conclusively that the punch operation was the method of choice but should

always be preceded by thorough preparatory drainage until functional tests show sufficient improvement in renal function to warrant an operation.

ORIGIN OF THE CONDITION

A large amount of literature has accumulated concerning the origin of obstructing valves. In 1870, Tolmatschew attempted to explain the occurrence of the valves by stating that they were simply enlargements of the folds and ridges which commonly occur in the normal urethra, stating that if these became hypertrophied, obstruction would result. The occurrence of the condition in early childhood and even in stillbirths convinced early observers that the condition was one of embryological origin. Bazy brought forward the theory that the valves represented a persistence of the urogenital membrane. He derived his theory from the fact that this structure in its later development occupies the site corresponding to the common location of the valves. In 1914, Lowsley introduced another theory in which he concluded that they might be considered as anomalous developments from the wolffian and muellerian ducts. In 1918, Watson, while working upon the embryological development of the verumontanum, found, in a cross section of the urethra in a fetal stage, three fibrous bands, extending from the proximal part of the verumontanum to the roof of the posterior urethra. They appeared to represent an attachment of the tip of the colliculus to the roof of the urethra, and he drew the deduction that congenital valves were a result of fusion of the colliculus, at an early stage of its development, with the epithelium of the roof of the posterior urethra (Fig. 14). In our previous paper from this clinic, there was made a very careful analytical study of the various forms in which the valves occurred. By studying critically the cases in the literature and our own, we have concluded that the congenital obstruction always occurs as one of the three types or formations as shown. Our conception of the position of the three types is shown in Figure 15.

Type 1. In this, the most common type, there is a ridge lying on the floor of the urethra, continuous with the verumontanum, which takes an anterior course and divides into two fork-like processes in the region of the bulbo-membranous junction. These processes are continued as thin membranous sheets, directing upward and forward, which may be attached to the urethra throughout its entire circumference. In the majority of cases of this general type, the fusion of the valves anteriorly is not complete. There exists at this point a slight separation of the folds. However, in a few of the cases, of which Lowsley's, Knox's, and Sprunt's are examples, the anterior fusion is complete while a cleft exists between the folds posteriorly. Another subdivision which really belongs to this general type consists of but a single instead of a double valve.

Type 2. In the second general type of which we have one example, there occurs a more or less cylindrical ridge similar to that found in the preceding type, with the exception that it passes over the upper aspect of the verumontanum toward the internal sphincter. Here it divides into two fork-like processes, which are continued as membranous sheets and are attached to the urethra just outside the internal sphincter, in a manner similar to that described in the foregoing type (Fig. 17).

Type 3. There is a third type which has been found at different levels of the posterior urethra and which apparently bears no relation to the verumontanum as do the types just considered. This was first mentioned by Jarjavy who describes it as an iris valve, because of the similarity in shape to the iris of the eye. This obstruction was attached to the inner circumference of the urethra, there being a small opening in the center. Incomplete varieties of this type have been described, the most common being a more or less crescentic or semicircular fold crossing the urethra and being attached either to the floor or roof (Fig. 16).

It is very evident from a review of the cases that there are considerable variations in the shape and position of the valves of any one type. Apparently no single theory, as stated previously, will explain satisfactorily the formation of all three types. This apparently suggests that the structures arise from a more variable structure than the urogenital membrane. We are inclined to favor Watson's theory as to their origin (Fig 14).

SYMPTOMATOLOGY

The symptom-complex characterizing the condition is very clear cut, and with careful examination of the history of the patient the diagnosis becomes almost self-evident. The symptoms may be divided into two headings: first, those brought about by a local obstruction to urination, and second, those resulting from the back pressure effect upon the kidneys producing renal damage, insufficiency, and a resulting uræmia. The symptom-complex under the former heading is sometimes very difficult to elicit. However, upon carefully questioning the patient, or his parents, one derives a history of continuous difficulty in

urination since birth. The patient has always had difficulty in starting the stream, and when started, it has always been very small with a tendency toward dribbling. There is usually present a marked frequency, and, very often, incontinence. This history of nocturnal frequency and incontinence, in many instances, leads to a diagnosis of enuresis. However, the incontinence is always of the paradoxical type resulting from the overflow of a greatly distended bladder which never becomes completely emptied. In children, the mother has usually noticed that the child has quite a large protuberant abdomen and that there has been marked growth impairment.

The symptoms coming under the second classification are those caused by the condition progressing to an advanced stage. They are those of chronic uræmia and simulate chronic diffuse nephritis or polycystic kidneys. They are briefly: anorexia, nausea, vomiting, headaches, loss of weight, and coma in the last stages. It has also been noted that in these cases the resistance to infection is very much lowered, due probably to the chronic uræmic state. Respiratory infections are very common, and they simulate very closely, with a very large residual urine, the old prostatic in their susceptibility to ascending renal infections. Upon physical examination, one finds usually an anæmic patient having a greatly distended abdomen. Upon abdominal examination one finds a distended bladder, usually bilateral masses in the lumbar regions, consisting of greatly distended kidneys, and bilateral hydro-ureters may sometimes be made out on each side of the abdomen. The patient may be in any one of the several progressive stages of chronic uræmia. They have usually considerable nitrogen retention in the blood. Upon attempting urethral instrumentation, one usually finds obstruction in the mid portion, but a very small catheter will sometimes pass readily. Often, however, only a small ureteral catheter can be introduced. However, retrograde instrumentation is very difficult due to the fact that the ballooned-out valves in the posterior urethra furnish a very definite obstruction. In some cases, urethral instruments are arrested by the valves. The prostatic urethra above the valves is dilated, and the vesical orifice is often so dilated that the valves can be seen from the bladder (Figs. 18, 19, and 20). There is marked hypertrophy of the trigone, the ureteral orifices are apt to be greatly dilated, considerable trabeculation, cellule formation, and occasionally diverticula are seen.

A great help has been added to the technique of diagnosing such conditions by the introduction of radiographic media. If the bladder is filled by the introduction of sodium iodide, usually a reflux up both ureters occurs, filling the pelvis of both kidneys, and the roentgenogram shows a large, dilated bladder with bilateral hydro-ureters and bilateral hydronephrosis. It is very interesting to note, in viewing the X-ray of such a condition, that the ureter from its juxtavesical portion to its entrance to the pelvis of the kidney has become greatly elongated, in addition to its dilatation. The weight of this elongated ureter, when filled with urine, tends to the formation of folds and kinks because of sagging. This kinking, sagging, and occasionally torsion of the ureter greatly increases obstruction to the outflow of urine from the kidney pelvis, and adds, to vesical neck obstruction, ureteral obstruction. The cystogram always shows dilatation of the vesical orifice and continuation of the opaque medium down the posterior urethra to the site of the valves, producing the typical funnel-shaped end to the cystogram which is different from the funnel seen in tabes, in which the funnel extends down to the external sphincter; whereas, in a case of congenital valves, it does not usually extend below the verumontanum as shown in Figures 18, 19, and 20.

DIAGNOSIS

In the differential diagnosis of this urinary condition the history, as mentioned above, is of greatest importance. The presence of the protuberant abdomen in an undernourished child, with difficulty in urination and often pyuria, should make one very suspicious. The distended bladder can usually be palpated and percussed. The palpation of bilateral masses, in the region of the kidneys and hydro-ureters, with a percussible bladder, helps greatly to confirm the suspicion. The most striking feature in these cases is the ability to see and palpate the greatly distended, tortuous ureters and marked hydronephrotic sacs through the emaciated abdomen of these marasmic children. In some cases that we have seen, the greatly enlarged ureters could be grasped between the thumb and finger and were thought at first to be distended, thickened intestines. When the symptoms and signs suggest prostatic valves, it is very unwise to cystoscope the patient immediately, because in doing so, one suddenly empties the bladder, ureters, and kidney pelves of a large residual urine, which the kidney has been working against under great pressure. We have found it advantageous to pass a small, soft-rubber catheter, or, in some cases, even a small ureteral catheter, and gradually

TABLE I.—OUR CASES OF CONGENITAL VALVES OF PROSTATIC URETHRA REPORTED IN 1919

Case number and date	Age	Symptoms	Clinical condition	Diagnosis	Treatment	Operative findings	Autopsy findings	Result	Remarks
1 11-11-12 Y. F. B.* No. 10	17 yrs.	Urinary difficulty since birth	Residual urine, pyuria; urethroscope shows 2 thin valves springing from crista urethralis	Urethroscopy; congenital valves in posterior urethra	Rupture of valves *per urethram;* urethroscope		Remains of valves (Type 2) previously described. Enlarged utricle, bilateral hydroureter and hydronephrosis	Well	Patient died of pneumonia 1 year later; see autopsy findings.
2 1-25-13 Y. F. B. No. 7	2 yrs.	Attacks of complete retention	Residual urine				One valve below verumontanum springing from lower end crista urethralis, left side	Dead	
3 8-19-13 Y. F. B. No. 6	21 mo.	Painful urination for 10 months. Periodical attacks of retention	Distended bladder; obstruction to catheter in posterior urethra; residual urine		Suprapubic cystotomy with external urethrotomy, with rupture of valves; sounds	Three membranous folds below verumontanum		Well	
4 8-25-13 Y. F. B. No. 5	20 mo.	Urinary difficulty and pain	Distended bladder; palpable mass each kidney region; reduced renal function; X-ray to demonstrate the point of obstruction	Congenital obstruction posterior urethra	Suprapubic cystotomy with destruction of valve; clamp and cautery	Just below vesical orifice vertical valve on left side		Well	Died 1 year later of diphtheria.
5 7-14-14 Y. F. B. No. 3	6 mo.	None until 2 days before admission, then abdominal distention	Catheter met with obstruction at external sphincter		Suprapubic cystotomy with rupture of valve in posterior urethra with finger	Valve in midportion prostatic urethra		Well	
6 5-18-15 Y. F. B. No. 9	12 yrs.	Difficult and frequent urination since birth	Large residual urine; pyuria. Obstruction to catheter, posterior urethra. Cystogram; reduced renal function	Congenital obstruction	Suprapubic cystostomy with destruction of valve	At about level verumontanum; crescentic band across roof of urethra		Well	
7 3-1-16 V. F. B. No. 1	11 da.	Vomiting, abdominal distention; urinary retention	Distended bladder; obstruction to catheter	Abdominal tumor	Exploratory laparotomy	Mesenteric and urachal cyst	Division crista urethralis below verumontanum into 2 valves	Dead	
8 B. U. I. 4938 3-17-16 V. F. B. No. 11	26 yrs.	Dysuria and urinary frequency for 9 years	Residual urine, pyuria, urethroscope shows 1 valve below verumontanum springing from crista urethralis	Urethroscopy; congenital valve in posterior urethra	Excision of valve with "punch"	Single valve on right side of urethra below verumontanum		Well	Excision followed by partial incontinence.
9 7-30-16 V. F. B. No. 4	15 mo.	Loss of weight, vomiting	Distended bladder; pyuria. Residual urine; reduced renal function				Two valves below level of verumontanum	Dead	
10 B. U. I. 6530 6-2-17 V. F. B. No. 12	42 yrs.	Urinary difficulty since early childhood. Frequency, nocturnal enuresis	Residual urine; pyuria; urethroscope shows 2 valves springing from verumontanum, running toward external sphincter; reduced renal function	Urethroscopy; congenital valves in posterior urethra	Excision of 1 valve with "punch"	Bilateral valves of urethra below verumontanum		Well	Marked improvement.
11 10-15-17	3 mo.	Loss of weight and vomiting	Pyuria				Specimen destroyed	Dead	
12 12-8-17 Y. F. B. No. 8	4 yrs.	Dysuria. Persistent suprapubic fistula	Pyuria; a persistent suprapubic fistula (postoperative)	Contracture of vesical neck	Suprapubic cystostomy with passage of large sounds			Well	

*Young, Frontz, and Baldwin. J. Urol., 1919, iii, 289-345.

TABLE II.—CASES OF CONGENITAL VALVES OF THE PROSTATIC URETHRA REPORTED HERE FOR FIRST TIME

Case number and date	Age	Symptoms	Clinical condition	Diagnosis	Treatment	Operative findings	Autopsy findings	Results	Remarks
1 B. U. I. 8555 2-24-20	7 yrs. 11 mo.	Frequency, dribbling, enuresis	Bladder to umbilicus. Residual 200 c.cm., 30 c.cm. massaged from left ureter. Valves of posterior urethra connected with verumontanum	Congenital valves	Punch operation (special No. 17 punch). Valve and part of verumontanum removed			Well	Within a few days voiding only 3 to 4 times during the day and holding urine 10 hours at night.
2 B. U. I. 8728 4-26-20	7 yrs.	Incontinence, diurnal and nocturnal. Frequency	Pyuria. Residual 200 c.cm. congenital valves of posterior urethra	Congenital valves	Suprapubic cystotomy. Punch operation. Passage of sounds	Congenital valves, dilated prostatic urethra. Iris valve		Well	Sinus healed promptly. Urinating normally in 4 weeks. No residual. Excellent result.
3 B. U. I. 9023 8-17-20	10 yrs.	Incontinence, diurnal and nocturnal	Residual 550 c.cm. Dilatation of posterior urethra (X-ray)	Congenital valves	Suprapubic cystotomy, rupture of valves with sounds. At a later date punch operation	Congenital valves. Dilated posterior urethra		Improved	The suprapubic sinus persisted until July, 1924. Voids 8 to 10 times day and 2 to 4 times night. Passes as much as 16 ounces at one time.
4 B. U. I. 10155 12-6-21	9 yrs.	Frequency. Incontinence (diurnal)	Internal orifice dilated. Valves running upward from each side of verumontanum	Congenital valves of posterior urethra	Punch operation. Dilatation of urethra with sounds	Congenital valves		Improved	Capacity 4 to 8 ounces (before operation 60 c.cm.). Dribbling during day continued if active.
5 B. U. I. 12427 5-24-24	15 yrs.	Nocturnal incontinence. Hæmaturia. Frequency	Mitral regurgitation. Distended bladder. Residual 200 c.cm. Valves of posterior urethra. Bifid ureter and pelvis, left hydroureter and hydronephrosis. Hourglass type of bladder	Congenital valves posterior urethra. Dilated posterior urethra. Hydronephrosis, left	Retention catheter. Blood transfusion		Congenital diverticulum and obstruction of urethra. Pyelonephritis and cystitis	Died 7-7-24	Entered hospital in poor condition.
6 B. U. I. 15354 10-23-26	11 yrs.	Difficulty in urinating. Symptoms of uræmia	Dilated bladder. Bilateral hydroureters. Bilateral hydronephrosis N. P. N. 160 mgm. Creatinine 12 mgm.	Congenital valve posterior urethra	Punch operation. Dilatation with sounds			Well 2 yrs.	Normal bleod chemistry. Leading normal life.
7 B. U. I. 13248 2-13-25	2 yrs. 9 mo.	Dysuria. Frequency. Incontinence. Hæmaturia. Uræmia	Distended abdomen. Hydroureters. Uræmia	Congenital valve posterior urethra	Decompressed bladder			Dead 3-1-25	Entered hospital uræmic. Progressively more uræmic. Death, uræmic coma.
8 B. U. I. 16033 10-14-27	7½ yrs.	Dysuria. Pyuria. Chills and fever. Frequency	Stoppage of stream during urination. Cloudy urine	Congenital valve posterior urethra	Valves partially ruptured by previous sounding. Treated by frequent soundings and bladder irrigations			Well	Remains of torn valves seen at first cystoscopy.
9 B. U. I. 16577 9-14-27	4 yrs.	Distended abdomen. Dysuria. Pyuria. Incontinence	Distended bladder. Bilateral hydroureters. Bilateral hydronephrosis	Congenital valve posterior urethra	Punch operation. Dilatation with sounds			Well	Well 10 months. Gained weight. Voids freely.

TABLE III.—CONGENITAL VALVULAR OBSTRUCTION OF THE POSTERIOR URETHRA
COLLECTED CASES FROM THE LITERATURE

Author and date	Age	Signs and symptoms	Cystoscopy and urography	Treatment	Remarks
Budd 1840	16 yrs.	Unconsciousness; in dying condition upon entry			Autopsy showed bilateral hydronephrosis and hydro-ureter. Bladder hypertrophied and dilated. Valvular obstruction in membranous urethra.
Bednar 1847	12 da.	Premature infant with marked weakness and abdominal distention. Urinary retention for 5 days			Verumontanum at autopsy showed division at lower end into 2 concave folds facing the bladder. Bilateral hydronephrosis and renal atrophy.
Godart 1854					Autopsy showed membranous valve at level of verumontanum in posterior urethra, with free edge toward the vesical neck.
Picard 1855	40 yrs.	Difficulty in urination and uræmia convulsions. Distended bladder			Autopsy showed valvular obstruction below the verumontanum. Bilateral hydronephrosis and hydro-ureter.
Tolmatschew 1870					Autopsy showed 2 valves just below the verumontanum.
Eigenbrodt 1891–1892	54 yrs.	Urinary disturbances and difficulty of 8 years' duration. Complete retention for last 2 years		Suprapubic cystotomy; mucous membrane fold hanging like a curtain over vesical neck and causing obstruction. Valve destroyed	Valve was found intravesical; resected in bladder. Probably not a true posterior urethral valve. Normal. Results good, able to void good stream.
Poppert 1892	24 yrs.	Difficulty in urination since childhood. Partial retention with dysuria and tenesmus	Urethroscopic examination showed mucous membrane obstruction near vesical neck	Retention catheter inserted. Patient died following day	Autopsy showed mucous membrane fold coming from vesical neck. Filled neck so as to cause semilunar valvular obstruction. Bilateral hydronephrosis and hydro-ureter.
Christen 1895					Valvular stricture in prostatic region following on an hypertrophy of the crista.
Porak 1895	Still-birth				Dystocia due to enlarged abdomen. Large, thin bladder, 120 c.cm. In posterior urethra was a mucous fold in shape of valve with concavity toward bladder. Extended into the membranous urethra, terminating at the verumontanum and occupying one-half of the urethral canal. Bilateral hydro-ureter and hydronephrosis.
Schlagenhaufer 1896	Died at birth				Valvular obstruction at lower end of verumontanum.
Commandateur 1898	Died at birth				Autopsy showed delicate valve-like structure at lower end of verumontanum. Bilateral hydronephrosis.
Fuchs 1900	5 mo. fetus				Autopsy showed valve-like ridge anterior to verumontanum. Bilateral hydronephrosis and hydro-ureter.
Fuchs 1900	Still-birth				Autopsy showed valvular obstruction below the verumontanum.
Lindemann 1904	4 mo.	Œdema of eyelids and extremities			Autopsy showed valvular obstruction below the verumontanum. Bilateral hydronephrosis and hydro-ureter.
Lindemann 1904	4 yrs.	Acutely ill for 8 days			Patient died of diphtheria. Autopsy showed valvular obstruction with 6 folds below verumontanum. Bilateral hydronephrosis and hydro-ureter.
Lindemann 1904	5½ yrs.	Difficulty in urination. Distention of bladder			Autopsy showed valvular obstruction from anterior end of verumontanum. Bilateral hydronephrosis and hydro-ureter with renal atrophy.
Morton 1904	13 mo.	Abdominal distention, vomiting and anorexia. Distention disappeared with catheterization			Autopsy showed valvular obstruction on roof of posterior urethra. Bilateral hydronephrosis and hydro-ureter.
Posner 1907	11 yrs.	Scarlet fever followed by pain in right kidney region, with pyuria and hæmaturia. Bladder distention		Frequent catheterization	Probably stricture of membranous urethra. Not counted as true urethral valve.

TABLE III.—*Continued*

Author and date	Age	Signs and symptoms	Cystoscopy and urography	Treatment	Remarks
Thompson 1907	14 mo.	Dysuria and difficulty in urination. Distended bladder		Suprapubic cystotomy	Autopsy showed membranous valvular obstruction in posterior urethra.
Fletcher 1908	3 mo.	Abdominal distention. Convulsions, progressive anæmia and malnutrition. Tumor in upper left quadrant, also smaller ones in upper right quadrant and above symphysis		Operation begun but stopped immediately because of patient's poor condition	Autopsy showed 3 membranous valve-like obstructions in posterior urethra. Bilateral hydronephrosis and hydro-ureter.
Wilckens 1910	2½ yrs.	Diphtheria for 10 days. Convulsions			Autopsy showed valvular obstruction anterior to verumontanum.
Lederer 1911	11 yrs.	Urinary difficulty 5 years' duration. Incontinence, dysuria and pyuria			Autopsy showed semicircle diaphragmatic membranous obstruction below verumontanum. Bilateral hydronephrosis and hydro-ureter.
Knox and Sprunt 1912	5 yrs.	Incontinence since birth. Marked pyuria. Loss of weight and strength. Distended bladder and masses in both kidney regions			Autopsy showed valvular obstruction just below verumontanum. Bilateral hydronephrosis and hydro-ureter.
Heinecke 1913	5 yrs.	Difficulty in urination since birth, with occasional complete retention. Fever and marked pyuria		Suprapubic cystotomy	Autopsy showed 2 valves at lower end of verumontanum. Bilateral hydronephrosis and hydro-ureter.
Jordan 1913	4 wks.	Continued dribbling			Autopsy showed fibrous stricture of posterior urethra, probably not case of true posterior urethral valve.
Iverson 1914	85 yrs.	Hæmaturia and difficulty in urination. Distention of bladder.		Repeated catheterization unsuccessful; a false passage produced in posterior urethra	Autopsy showed large adenoma of prostate; valve probably artefact from false passage.
Lowsley 1914	3½ mo.	Acutely ill; pulmonary œdema			Autopsy showed valvular obstruction at lower end of verumontanum in posterior urethra. Bilateral hydronephrosis and hydro-ureter.
Hinman and Kutzmann 1917	6½ yrs.	"Kidney trouble" with nausea and vomiting. Periods of urinary difficulty and retention. Cystitis of 1½ years' duration	Cysto-urethroscopic examination showed membranous valves in the posterior urethra	Suprapubic cystotomy and external urethrotomy with destruction of membranous valves in posterior urethra	Uræmic attack several months later; necessitated a second suprapubic cystotomy for permanent fistula.
Hinman and Kutzmann 1920	57 yrs.	Diurnal frequency with occasional hesitancy, diminishing in size and force of stream, 4 months' duration	Cysto-urethroscopic examination showed a valve-like formation of the superior crista. Median bar at vesical neck with definite bas fond formation	Suprapubic cystotomy with resection of valves and median bar	Patient voiding normally 4 years after operation. Residual cystitis.
Hinman and Kutzmann 1922	4 yrs.	Partial retention and dribbling, nocturnal and diurnal frequency associated with dysuria — duration of 2 years	Residual of 300 c.cm.; prostatic urethra shows dilated internal sphincter. Inferior crista shows redundant mucous membrane folds in fan shape, causing a valve-like obstruction. Cystogram shows a marked dilatation and elongation of left ureter	Destruction of valves by several fulgurations	Able to void a good stream. Phthalein has increased from 35 to 50 per cent in 2 hours. Still has a cystitis present.
Hinman and Kutzmann 1923	4 yrs.	Pain in right loin with partial retention of urine of 2 weeks' duration, marked dysuria	Cystoscopy revealed a concentric valve-like formation just distal to the verumontanum	Valve destroyed by fulguration	Immediate relief not very marked. Patient lost sight of.
Hinman and Kutzmann 1924	2 yrs.	Continual dribbling of urine. Unable to void good stream since birth. Very irritable and fussy	Cystoscopy revealed valve-like obstruction in posterior urethra. Pyelography showed bilateral hydronephrosis and hydro-ureter	Suprapubic cystotomy with splitting of valves in posterior urethra. Bar at vesical neck incised	Able to void good stream. Patient's disposition completely changed to happiness and contentment. Cystitis still present.

TABLE III.—*Continued*

Author and date	Age	Signs and symptoms	Cystoscopy and urography	Treatment	Remarks
Hinman and Kutzmann 1924	18 yrs.	Swelling of legs and face and weakness. Albuminuria of approximately 10 years' duration. Marked pyuria. No difficulty, hesitancy, dysuria, etc.	Not able to insert cystoscope into bladder. View not a very clear one—thought to have valvular obstruction in posterior urethra. Cystogram shows small bladder, markedly dilated and tortuous left ureter and an atrophic left kidney	Suprapubic cystotomy for vesical drainage. Patient in uræmia	Died fourth day postoperative in uræmia. Autopsy of urinary tract showed anomalous vesical neck; left ureter large and tortuous opening in pouch of posterior urethra; left kidney atrophied; right ureter dilated; right kidney hydronephrotic but also solid and granular.
Silverberg 1920	8 yrs.	Enuresis and frequency leading to marked dysuria and pyuria. Bulging mass in left loin	Cystoscopy unsuccessful. Argyrol 5 per cent. Cystogram showed dilated bladder and bilateral hydro-ureter and pyonephrosis		Case disappeared—no follow up.
Randall 1921	5 yrs.	Dysuria and interruption of stream. Drowsy on entry to hospital	Membranous obstruction seen at the verumontanum. Pus seen coming from right ureter—culture showed bacillus pyocyaneous	Fulguration of valves. Kidney pelvis lavaged with ½ per cent $AgNO_3$	Patient well 3½ years later.
Randall 1921	16 yrs.	Frequency and enuresis of 2 years' duration, associated with suprapubic pain. Also slight hæmaturia	Posterior urethra dilated. Vesical neck raised and relaxed. At extremity of verumontanum is seen a fine frenulum extending distally about 1 cm. and, in dividing, forms a valve on either side. Cystogram—small bladder with right hydronephrosis and hydro-ureter	Destruction of valves by fulguration	Able to void freely following treatment.
Martin, J. 1922	21 yrs.	Hypospadia with painful pollakiuria, pyuria and hæmaturia. Dysuria of 11 years' duration. Cystotomy performed with no relief because of wrong diagnosis	Urethroscopy showed a smooth partition about the verumontanum	Suprapubic cystotomy with resection of semilunar valve obstructing prostatic urethra	Symptoms completely relieved. Rare case because of association with hypospadias.
Glingar 1922	40 yrs.	Dysuria and pain in perineal region. Urethra impenetrable to any form of catheeter	Urethroscopy showed a broad compact bridge of tissue between the posterior declivity of the colliculus and upper wall of the posterior urethra with a central narrow sagittal slit	Destroyed through the endoscope	Able to void and be catheterized after several treatments.
Glingar 1922	19 yrs.	Urethritis (non-specific) and cystitis of 2 years' duration. Unable to catheterize or cystoscope	Urethroscopy showed a wide curtain-like band at the internal orifice with 2 small openings to either side	Destroyed through the urethroscope	End-results not stated.
Martinson and Reuben 1923	5 yrs.	Enuresis, diuria, and nocturia	Not done		Autopsy showed hydronephrotic kidneys and hydro-ureters with a distinct fold of mucous membrane with valve-like action at base of posterior urethra, opening toward the bladder.
Schmidt 1923	Stillbirth 7 mo. premature				Autopsy showed markedly distended bladder and bilateral hydronephrosis and hydro-ureter. Urethra opened into bladder at angle of 45 degrees and a fold of bladder mucous membrane formed a valve-like obstruction at neck.
Hausmann 1924	1 mo.	Loss of weight, projectile vomiting and irritableness. Suprapubic mass. Inability to void. Disappearance of suprapubic mass with fulguration			Autopsy showed bilateral pyonephrosis and hydro-ureters. Bladder thickened. Posterior urethra funnel-shaped. Two membranous folds rising from verumontanum, forming valve-like obstruction.

TABLE III.—*Continued*

Author and date	Age	Signs and symptons	Cystoscopy and urography	Treatment	Remarks
Bronner 1924	2½ yrs.	Urine passed in jets; periods of retention followed by dribbling. Bladder to umbilicus—400 c.cm. Also rickets and pulmonary tuberculosis	Cystogram showed dilated prostatic urethra, forming a cone-shaped process in middle of which was a clear space corresponding to the projecting colliculus and inferior crista	Suprapubic cystotomy—death in few days due to sepsis	Autopsy—bladder showed thickening. Prostatic urethra and internal sphincter dilated. Colliculus projected in from dorsal wall; below colliculus was a sagittal fissure formed of small folds, separating the prostatic and membranous urethras. Bilateral hydroureter. Semilunar valve in left ureter just above orifice; bilateral infected hydronephrosis and suppurating nephritis.
Ehrich 1925	14 yrs.	Enuresis since early childhood. Occasional diurnal incontinence	Ureteral orifices negative. Pouching of bladder wall behind trigone. "Cavity between internal sphincter and verumontanum very deep and folds of tissue noticed running upward and backward on each side." Cystogram—no diverticula; no regurgitation into ureters	Suprapubic cystotomy with destroying of valves	Uneventful recovery. Six months later—residual of 2 ounces. Relieved of nocturna incontinence.
Schultz 1925	31 yrs.	Gonorrhœa. Urethral stricture. Persistent urethral discharge not responding to instrumentation. Chronic urethritis	Endoscopic examination showed valvular obstruction in prostatic urethra. Cystoscopy showed valves on urethral wall connecting with verumontanum	Sounds and irrigations	Uneventful recovery.

decompress the bladder in the same way that one deals with large residual urine secondary to prostatic obstruction. After the urinary tract has been emptied and a point of equilibrium has been established in the blood chemistry, a study of the bladder may then be carried out. The cystogram can then usually be carried out favorably with the patient's head depressed so that the fluid can easily flow upward into the dilated ureters and kidney pelves. This filling is allowed to progress until the entire urinary tract is completely distended, when the catheter is removed and a stereoscopic roentgenogram is taken, after which the catheter is reintroduced and with patient in a sitting posture, the shadowgraphic fluid is allowed to escape completely and the bladder is washed out thoroughly with salt solution to avoid irritation. There may be some reaction following this examination and as a rule several days should be allowed to elapse before carrying out the second important step, viz.: cystoscopy. A child's cystoscope is usually passed into the bladder, and by withdrawing this, one can view the valves in the prostatic urethra. The instrument can be used to study the prostatic urethra because the vesical orifice is dilated. When the irrigating fluid is turned on and off, the valves balloon out and then partially collapse. A small straight tubular air urethroscope is also an excellent instrument for studying the valves. The internal sphincter has been found dilated in our cases and one notes a funnel-shaped dilatation of the prostatic urethra quite similar to that seen in prostatectomy in cases in which the internal sphincter has been damaged, but not extending below the verumontanum. The bladder presents a picture of obstruction. The trigone is hypertrophied, the ureteral orifices are usually dilated, and the bladder wall shows marked trabeculation, cellules, and, sometimes, diverticula. A cystogram should always be taken. Dilatation of the upper urinary tract is present. In some cases, regurgitation up the ureters does not occur and one is uncertain whether dilatation of the upper urinary tract is present. Cystoscopy is always indicated for correct diagnosis. Sometimes it is very difficult to introduce a child's cystoscope and in such cases filiforms and followers are first passed. When difficulty is encountered, it is partially due to the beak of the cystoscope meeting obstruction in a pouch in front of the valve or at the verumontanum itself. In the iris type of valve, the aperture in the valve is occasionally not large enough in diameter to admit even a small cystoscope. By means of a urethroscope, an excellent view of the valves and opening between them may often be obtained. In an adult, a No. 26 straight tube may be employed. In boys of 5 years of age we have had no difficulty in employing an endoscope made from a No. 15 tube. For very young infants it may be necessary to prepare urethroscopes with tubes of smaller caliber. The urethroscope shows the opening between the valves much better than the cystoscope, the beak of which has to be passed through them

before the valves are seen. The condition should be differentiated from congenital polycystic kidneys and the condition known as congenital hypertrophy of the verumontanum, as reported by Bugbee and Wollstein. Recently, in this clinic, we have had a number of neurological bladders occurring in children, with a condition of spina bifida occulta present which may suggest congenital valves. These children have the large bladder, difficulty in urination, paradoxical incontinence, and symptoms of chronic uræmia. The cystoscopic and radiographic methods make differentiation easy.

TREATMENT

As shown in the cases which have been given in detail above, the ideal treatment for valves of the posterior urethra appears to be as follows:

Careful abdominal examination should be made to see whether the bladder, ureters, and kidneys are palpably dilated. Blood ureas should be taken to see whether renal impairment is present. Instrumentation of the urethra should be carried out delicately to detect the valves, to note the position, and if obstruction is met with, to find some instrument, generally a small pointed ureteral catheter, which can be passed through the slit between the valves to catheterize the bladder. Care should be taken not to empty the bladder too rapidly. A small catheter will, however, allow only a small escape of fluid, and the decompression apparatus is usually, therefore, not necessary. If the evacuation appears too rapid, even through the ureteral catheter, the outflow can be diminished by carrying the catheter over a slight elevation. If a larger catheter is used in the presence of a markedly distended bladder, we have found the Young-Shaw decompression apparatus very valuable, not only to determine the vesical pressure, but to provide drainage under gradually lessening pressure for several days until the apparatus can be safely removed and free drainage through a dependent catheter permitted. In one of our cases we now believe that the evacuation was too rapid, and that by prolonging the decompression, fatal result might have been avoided, although the renal function was very bad. When the bladder, ureters, and kidneys have been thoroughly drained, if the condition of the patient warrants it, one should make a cystogram. Sufficient fluid to fill the bladder, ureters, and kidney pelvis (if reflux is present) should be introduced. Stereo-films should be taken so that the contour of the bladder, ureters, kidneys, and the funnel shaped projection into the prostatic urethra may be clearly seen. The sodium iodide solution should be carefully drained away and lavage of the bladder carried out to avoid irritation. Cystoscopy should be carried out as soon as the condition of the patient permits. By using a very small No. 12 child's cystoscope one can usually penetrate the slit between the two valves by careful manipulation, and thus obtain an excellent view of the bladder and prostatic urethra, during which the valves can usually be seen, and their extent and site of attachment described. In one case in which it was possible to introduce the cystoscope into a dilated ureter, we were able, by using the extra long straight operative cystoscope which is employed in Young's cystoscopic lithotrite, to introduce the cystoscope up to the pelvis of the kidney, and when withdrawn the greatly dilated ureter with its convolutions and tortuosities and valve-like septa were seen (Fig. 2). Unfortunately, the operator failed to try to identify the renal papillæ and jets of urine which are supposed to come from the urinary tubules, but we believe that this might easily be possible in some of these cases. Endoscopy has also been carried out in some of these cases with a special small child's endoscope. In this way a better view is obtained of the aperture between the two valves after the endoscope is drawn outward below the level.

PREPARATORY TREATMENT

These cases require practically the same preparatory treatment as cases of prostatic hypertrophy with marked back pressure and much residual urine. As noted above, great care must be taken in providing slow evacuation of the greatly distended bladder, ureters, and kidney pelvis, the condition of the patient being carefully studied by renal function tests (non-protein nitrogen output and phthalein) and blood pressure and cardiac examinations to determine the effects of decompression. Drainage should be maintained until the drop in non-protein nitrogen and increase in phthalein is sufficient to warrant the slight operation necessary to remove the valves. One cannot expect restoration to normal, and in many cases there is still a marked impairment of renal function when the valves are excised with the punch.

The punch operation. In boy babies it is quite possible to pass a No. 7F. punch instrument into the urethra, and, by careful manipulation, through the aperture between the valves and on into the bladder. The bladder is then washed out and filled again with a weak antiseptic solution. It has seemed wise to remove only one valve at the first operation. This is carried out by turning

the fenestra of the instrument to one side, withdrawing the outer sheath until the valve is entrapped in the fenestra. A few manipulations back and forth will determine that this is correct and that the instrument has not escaped beyond the valves. When the inner tube is pressed home, the valve is completely excised and removed, and the instrument is then withdrawn (Fig. 21). The patient can then be removed from the table and should be instructed to void. If urination is free and the stream forcible, it is probably not necessary to introduce a catheter, and if during the next few days, micturition continues satisfactorily, no additional operation is necessary. Should it be evident that the obstruction has not been completely removed, another cystoscopic examination to determine the presence of a remaining valve and an additional cut with the punch instrument on the opposite side, may be advisable. In one of our early cases one of us (Young) undoubtedly overdid the punch operation in taking five cuts, and as a result, slight incontinence persisted. Since then no cases of incontinence among the 7 cases treated by the punch have been recorded (Fig. 22). If, immediately after the operation, the patient is unable to void freely, or if the phthalein and nonprotein nitrogen output tests show considerable impairment of the kidneys still present, it is probably better to employ a large urethral catheter for drainage and free evacuation of the distended urinary tract. Such catheters should be removed every few days and the duration of the drainage determined by the progress of the improvement in renal function, etc. The punch operation is so simple and painless that in most cases we have found anæsthesia entirely unnecessary. In several of the cases which we have encountered and recorded, the valves have been ruptured by the passage of instruments, sounds, catheters, cystoscopes, etc. In such cases it was possible to see the ruptured valve leaflets still attached to the verumontanum. In some cases, even though it was possible to pass a fairly large instrument, valvular obstruction persisted to a certain degree, so that the punch operation was required after the use of marked dilatation and sounds. The objection to the use of sounds is that false passages may sometimes be produced. In one of our cases we found quite a deep pouch in the floor of the urethra beneath the valve, into which instruments passed. It may even be necessary to use filiforms and possibly a punch which may be attached to a filiform in order to get the instrument through the aperture between the valve. If instrumental rupture of the valves is the method of treatment employed, the pre-operative and postoperative investigation and care should be the same as that described above for punch operation.

Suprapubic operation. In the first case in which the condition was discovered and cured by operation in 1912, Young opened the bladder suprapubically and discovered the dilated prostatic urethra and a thin valve was detected by palpating upon the end of a sound which had been passed through the meatus. By means of a knife and rongeur the valve was easily excised completely, after which large instruments could be passed through the urethra into the bladder. This procedure has been carried out in this clinic in several other cases, but since demonstrating that the punch operation is entirely satisfactory, we have personally always adopted this in preference to the suprapubic or any other method of attack.

Perineal operations. This method of approach was suggested as an alternative route in the paper by Young, Frontz, and Baldwin, but we have personally never found this necessary or even advisable. Hinman has advised urethrotomy of the bulbous urethra for the passage of cystoscopes or other instruments, and through this has carried out fulguration.

Fulguration. This was first carried out by Alexander Randall, who reported two cases. By means of the high frequency current and a ureter catheterizing cystoscope, the valves were destroyed by fulguration. Four additional cases have been reported by Hinman, in which this method was employed. By the use of a child's single catheter cystoscope of No. 15F. size, no great difficulty should be experienced in introducing the instrument and carrying out fulguration in boys; in older cases the larger ureter catheterizing instrument may be satisfactorily employed. In babies one may encounter considerable difficulty in introducing the catheterizing cystoscope. For such cases we constructed our first baby punch and have found this so satisfactory that fulguration has not been employed in any of our cases. It would seem more radical and surgical to remove the valve by excision with the punch, and it gives a nice specimen of the valve for examination. Fulguration is, however, we believe, quite preferable to rough dilatation with sounds.

PROGNOSIS

Prognosis depends very greatly on the extent of the obstruction, the character of the renal impairment, and general condition of the patient. As this condition is present during fetal life, these patients are usually born with urinary incontinence and some degree of renal impairment. In a few

cases the valvular obstruction is undoubtedly responsible for stillbirths, and in others the patient lives only a few days or weeks. When at birth examination reveals an emaciated, unhealthy boy with a distended abdomen, one should be suspicious of congenital valvular obstruction. If palpably enlarged bladders, kidneys, and ureters are made out, the diagnosis is practically certain. An attempt to pass small instruments will usually reveal the site of obstruction in the prostatic urethra. Continued efforts to pass small ureteral catheters will generally be rewarded by evacuation of urine, and the subsequent introduction of sodium iodide and X-ray examination will make the diagnosis positive and delineate the extent of the ureteral and renal dilatation. Only by the greatest care will it be possible to save the lives of these desperately ill children, and in some cases the impairment and general deterioration is so great as to make it impossible to save them. Where it is possible by careful preparatory treatment to improve the renal function and general condition sufficiently so that the operation may be carried out, complete cures may be expected in a large percentage of the cases, as shown by the fact that we have now operated upon 15 cases without an operative death. All but two have apparently been permanently cured or greatly improved.

SUMMARY

We report herewith 21 cases of congenital valve of the posterior urethra which have been seen at the Brady Urological Institute. Two of these cases were reported by Young in 1913 and were the first cases in which operative procedure was carried out for this condition which had been recognized clinically. In a second paper (Young, Frontz, and Baldwin) 10 additional cases were reported. In this paper the 9 other cases are given in detail. Of these 9 cases 7 were operated upon successfully, 5 of which were treated with Young's baby punch with excellent results. The results in all these 7 operative cases have been excellent. Of the 21 cases which we have now seen, 15 have been operated upon successfully.

We have been able to collect from the literature 41 cases, of which 12 were treated by operation all since our first report. Of the last 9 cases seen at this clinic, all have been under 16 years of age.

The following things are stressed: the importance of complete urological examination and of a careful history; the search for dilated bladder, ureters, and kidney pelves; the necessity of blood chemistry, if valvular obstruction and renal impairment is suspected; delicate instrumentation to detect the valvular obstruction; careful efforts to find the aperture between the valves by means of pointed ureteral catheters in order to drain the bladder; the necessity of gradual decompression to avoid shock, uræmia, etc.; the use of the cystoscope or urethroscope and cystogram to demonstrate the valvular obstruction; the dilated prostatic urethra above it; the dilatation of the bladder, ureters, and kidney pelves into which the fluid usually flows by reflux; the necessity of careful preliminary treatment before operation is undertaken; the great advantage of the punch operation, with minute instruments especially prepared to fit the caliber of the urethra, given in detail in the cases cited.

The results obtained with this method are highly satisfactory. We wish to bring this condition before the profession in order to stress the importance of early diagnosis from a properly obtained history and physical examination, and to show the simplicity of its treatment with the punch operation, and the excellent results which may thus be obtained.

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SURGICAL TREATMENT OF UNDESCENDED TESTICLES

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ALTHOUGH the chief purpose of this article is to describe in detail Ombrédanne's technique for orchidopexy, a brief review of the literature concerning various phases of the treatment of undescended testicle may not be out of place.

Since the earliest publications of John Hunter dealing with the undescended testicle, numerous articles on this subject have appeared in the literature. The etiology has been discussed and many theories have been advanced as to the causative factors of this condition. Many types of operation have been described which have been undertaken in the attempt to restore the testes to their normal position and to preserve the function of these organs.

INCIDENCE

Statistics compiled by various authors agree quite uniformly regarding the frequency of this condition. Marshall reported an incidence of 1.02 per cent in 10,800 men examined. Ziebert, in examining men for the Austrian army between the years 1870 and 1882, reported 14,057 cases among 6,962,543 men, an incidence of 0.2 per cent. In the report made by Eccles, undescended testicles were found in 2 per cent of 48,000 cases of hernia. Bevan states the frequency to be one in 500. In reporting the frequency in relation to the age of the patients, Coley later stated that undescended testicles were present in 3 per cent of 14,100 boys under 14 years of age; in 2.2 per cent of 3,848 boys between the ages of 14 and 21; in 0.2 per cent of 37,370 males over 21 years of age. Hofstaetter examined newborn males in order to ascertain the frequency of this condition. Among 450 male children born at term he found that 96 per cent were normal in respect to the position of the testis. Among 150 male children of premature birth, in 68 per cent the testicles occupied the normal position, and in nearly every case, after 8 to 10 days of extra-uterine life, the testicles were in the scrotum or could easily be slipped through the external ring. Burdick and Coley reported that 482 cases of undescended testicle were found at the Hospital for Ruptured and Crippled between the years 1891 and 1924. In this group the relation of incidence to age was as follows:

	Cases
Under 4 years	8
4 years	32
5 years	41
6 years	49
7 years	42
8 years	53
9 years	59
10 years	40
11 years	36
12 years	45
13 years	36
14 years	25
15 years	7
16 years	8
Not stated	1
	482

The war department has reported an incidence of 3.1 per 1,000 men examined for the draft, or 0.31 per cent. Rennes also reported 6 cases among 3,600 recruits.

SITE

Faulty descent of the testis occurs most frequently on the right side. In 239 cases of Coley's series the undescended testicle was on the right side, in 188 cases it was on the left side, and in 55 cases the condition was bilateral. This disproportion has also been noticed by other authors; for instance, Pasche reports that among 64 cases 18 were bilateral, 28 on the right side and 18 on the left. Meyers thinks that descent on the left side is more frequent because of the pressure exerted by the distended sigmoid.

ETIOLOGY

Many theories have been offered of the etiology of undescended testicle, among which are the following: (1) short spermatic vessels; (2) fusion of the testicles (synorchism); (3) fetal peritonitis; (4) adhesion of the cord and its structures in the vicinity of the internal ring; (5) faulty development of the internal oblique muscle and its conjoined tendon; (6) anomalous or defective development of the processus vaginalis; (7) abnormal position of the fetus *in utero;* (8) absence of muscle fibers in the gubernaculum testis; and (9) heredity.

That any single one of these causes is a constant etiological factor is difficult to reconcile with the conditions found at the time of operation, but the

abnormal descent may be due to a combination of factors which varies with the individual.

Adhesions are frequently present between the vas deferens and the adjacent tissues in the region of the internal ring or between the processus vaginalis and structures of the inguinal canal. At the same time, the spermatic vessels are shortened to such an extent that the placing of the testicle in the bottom of the scrotum without tension is rendered practically impossible. Alivisatos, however, states that the shortness of the vessels is an effect rather than a cause of abnormal descent. Turner ascribes this condition to faulty position *in utero*, stating that abnormal pressure of the thigh against the inguinal canal prevents the complete descent of the testicle into the scrotum.

Cases have been reported in the literature in which the condition has occurred in several generations of a family—Finotti, Buedinger, Gosselin, Vidal, Hofstaetter, and others having observed this tendency.

PATHOLOGY, ANATOMY, AND HISTOLOGY

Upon gross examination we find that the undescended testicle is usually smaller, less elastic, and less firm in consistency than is the normal testicle. Sometimes, but very seldom, the testicle does not have any connection with the vas deferens; and sometimes, also, only some yellow tissue is to be found, a trace of the undeveloped testicle; sometimes there is no testicle at all. Usually, however, the undescended testicle is present but, as we have said, is smaller and less elastic than the normal testicle.

Histologically considered, the undescended testicle has certain features which are constantly present. The investigations of Odiorne and Simmons revealed thickening of the tunica albuginea and of the basement membrane of the tubules. Diminution in the number of spermatogenic tubules also may be noted. These cells, which are few and irregular, may show evidences of degeneration, while the cells of Leydig may be increased in number and well developed. The absence of spermatids may be strikingly noticeable; in fact, Uffreduzzi states that spermatogenic cells are present in only 10 per cent of the cases. Caulk reports that these cells may also degenerate as adult life is reached and that most of the testicular tissue is then replaced by fibrous and fatty tissue; however, interstitial cells are usually present. If these cells are present—a condition which is responsible for the internal secretion upon which depends the development of secondary male characteristics—should the testicle be removed in such patients?

Many authors advise orchidectomy if the opposite testicle occupies the normal position; however, we see no rational cause for removing the undescended testicle, and the presence of interstitial cells would seem to be a forceful contra-indication.

Ombrédanne's opinion is as follows: "Before puberty an ectopic testicle looks on section like a normal child's testicle. Its epithelial cells are normal. The interstitial cells are proportionately more numerous than in an adult's testicle, but this is normal in a child. After puberty the interstitial cells are very numerous, and this is an argument against orchidectomy, if it can be avoided. After puberty, however, one will find only a few spermatogones, very rarely spermatids, and never spermatozoids. So that if the operation is to be useful, one must operate on the boy before puberty, because at that time the testicle is normal and one can hope that the testicle placed in a normal position will grow normally."

COMPLICATIONS

Many complications may be associated with the abnormal descent of the testicle. In the ectopic testicle there may be found (1) a malignant growth, (2) torsion, (3) pain, (4) inflammation, (5) atrophy; other complications which may be observed are (6) hernia, (7) hypogenitalism, and (8) psychic disturbances.

The association of a malignant condition of the testicle with its abnormal position has been discussed in a previous paper. Tanner collected 600 cases of malignant testicle from the literature up to the year 1922. Of the 452 cases of malignant growths of the testicle reported by Cunningham, 412 occurred in normally placed testicles. From Cunningham's report we may draw the conclusion that a malignant growth is fifty times more likely to develop in undescended testicles than in normal testicles, since the ratio of the incidence of the former to the latter is 1:500. Bulkley states that among every seventy-five testicles retained in the abdomen, one testis will become malignant, and Keyes also states that testes retained in the abdomen are more likely to become malignant. Ombrédanne points out that, although a malignant growth is frequently observed in these cases, it occurs only in adults. The association of tumors of the testicle with cryptorchidism in horses is well recognized.

Torsion may also occur, especially in cases of the type designated by Eisendrath as "migrating testes." In these cases, because of a congenital deficiency in the internal oblique muscle and its conjoined tendon, the testicle can more readily be moved upward and downward.

Sometimes an ectopic testicle will cause some pain when the patient is walking; sometimes, especially in adolescents, neuralgia will be noted. Pain, like torsion, is especially to be noticed in cases of "migrating testicle." Ombrédanne thinks that torsion rarely occurs in an ectopic testicle.

Because the abnormal position may favor trauma, inflammation or orchitis may occur. In fact, orchitis in an ectopic testicle gives special symptoms which are correlated with the position of the testicle and may appear to be unusually grave. Peritoneal symptoms are observed and a differential diagnosis must be made between orchitis, a strangulated hernia, torsion, or, in case the testicle lies in a deep iliac position, appendicitis. In such a case, one must always look for the testicle in the scrotum in order to avoid mistakes. Gonorrhœa is said to be very prone to attack the undescended testicle.

The association of undescended testicle with hernia has long been recognized. In a series of 80,736 cases of hernia, Coley found 1,357 undescended testicles, while Eccles reports 854 among 48,000 cases of inguinal hernia. Uffreduzzi states that 90 per cent of incompletely descended testicles are associated with hernia. Schonholzer states that hernia is found in 93 per cent of the cases; Rawlings in 75 per cent; Odiorne and Simmons in 57 per cent; while Rovsing states that hernia is present in 100 per cent of the cases. On the other hand, Turner reports a series of 43 cases of undescended testicles of which only 17 were associated with inguinal hernia. However, in spite of the disparity of the figures regarding this association, it is evident that hernia is frequently present in cases of undescended testicle.

ATROPHY

Atrophy ensues if the testicle is not restored to the normal position. The investigations of Moore, which were carried out on animals, demonstrated that if the testicle occupies a position in the abdominal cavity, the intra-abdominal temperature is too high for the preservation of its normal function. He also showed that if the normally descended testicle is placed in the abdominal cavity a microscopical examination will reveal degenerative changes of the seminiferous tubules in as short a time as 2 weeks. However, if the testicle is replaced in the scrotum before too long an interval of time has elapsed, it will again assume a normal appearance.

Either of two types of hypogenitalism may be manifested clinically in cases of undescended testicle, namely, Froelich's syndrome or congenital hypogonadism. Evidence of such a condition should be sought in the examination of these cases.

TYPES

There are two chief types of undescended testicle: that in which the descent is *incomplete*, and that in which it is *faulty*. Among the cases of the former type the abdominal and inguinal positions are evident. In the latter type of case the testicle may occupy a portion of (1) the pubic region above the symphysis pubis; (2) the femoral region over Scarpa's triangle; or (3) the perineal region that is, the region lateral and external to the scrotum.

In Coley's series the inguinal position was most common, occurring 73 times among 537 cases; the second most common location was in the upper part of the thigh, as observed in 13 cases, while the pubic or perineal position was not observed in any case in Coley's series.

DIAGNOSIS

The diagnosis can usually be made with relative ease. If the testicle is not found in the scrotum the areas mentioned above should be examined to ascertain the position of the organ, which is usually identified as a small, elastic, ovoid mass. The testicle can usually be palpated by careful manipulation of the inguinal canal and by gentle pressure downward and inward toward the pubic spine, but it is not always possible to palpate it even when it occupies this position.

Occasionally during examination the cremasteric reflex will draw a normal testicle high into the upper part of the scrotum, and this temporary position may be misleading. A migrating testis, such as has been described by Eisendrath, may move freely upward and downward and if it is in a child, a marked change in its position will occur if the child is straining or crying.

AGE FOR OPERATION

Opinions vary as to the correct age for operation. Certainly it should be done before the age of puberty is reached, and preferably between the ages of 8 and 12 years. Broca states that operation should be performed early. Sonneland advises operation between the ages of 10 and 12 years; Meyer, 8 to 10 years—and even earlier in bilateral cases. Coley operates between the eighth and twelfth years, while various other authors advise later periods—Duchesne operates between the ages of 10 and 20 years, and Carlier, between 17 and 25 years. After the eighth year the testicle has the opportunity to descend normally and, moreover, the structures are larger and more easily recognized than in earlier years.

As we have already noted, according to Ombrédanne, the histological picture presented in cases of ectopic testicle makes it essential that operation be performed not later than the twelfth year. In general he advises operation during the period between the sixth and eighth years in those cases in which the small testicle has not descended below the pubis, recommending also that the parents be told that the testicles of the child may or may not descend, but assuring them that the chance of obtaining favorable results is greater if operation is performed.

INDICATIONS FOR OPERATION

The complications which may accompany undescended testicle indicate the advisability of performing orchidopexy. However, if by manipulation the testis can be brought to the bottom of the scrotum, operation is contra-indicated, as descent will always occur at the age of puberty.

In some cases a testicle which cannot be brought to the bottom of the scrotum by manipulation may descend normally in the period between the tenth and twelfth years. Usually, however, if by manipulation the testicle cannot be brought to the level of the pubis at an early age, it will not descend unaided at any later age.

When the testicle cannot be found clinically, operation is indicated. The physician should always tell the parents, however, that cases do occur in which the testicle cannot be found even at operation.

As for the results of operation, the following figures show the location of the testicle after operation according to a report made in 1926 by Burdick and Coley. The results which were reported simply as "satisfactory," without any record of further observations, are classified as "not stated."

Position	Cases
Not traced	120
Not stated	127
Not palpable	13
Inguinal canal	13
Outside external ring	77
Upper scrotum	64
Scrotum	114
Thigh	9
Total	537

Excluding only the cases which were not traced, satisfactory end-results were secured in 42 per cent of these cases, this rate being based on the assumption that from the standpoint of location after operation, a testicle in the scrotum or upper scrotum is satisfactory. If the "not stated" cases are also excluded, the result would be considered satisfactory in 60 per cent of the cases. The authors consider that 50 per cent of the end-results were satisfactory.

In this same series the size of the testicle after operation was as follows:

Size	Cases
Not traced	120
Not stated	328
Not palpable	13
Atrophic	47
Normal	29
Total	537

According to these figures, in the total series 7 per cent of the testicles were of normal size after operation. If the "not traced" and "not stated" cases are excluded, 31 per cent of the testicles were normal in size. Probably 15 per cent might be considered as an approximately true proportion.

In his report of the end-results of 15 cases of undescended testes in which operations were performed by Bevan, Eisenstaedt states that in none of the ten patients who returned for follow-up examination was there any evidence of hernia. In this series the position of the testis was found to be midscrotal in four cases, and low scrotal in six of the cases examined after operation. An increase in the size of the testicle was noted in all cases that were traced.

Turner reported the end-results in 43 cases, in 70 per cent of which the transplanted testicles were well down in the scrotum.

Mixter reports a 0.5 per cent mortality. He secured satisfactory end-results in from 75 to 80 per cent of his cases. The relation of the end-results to the position of the testicle at operation is indicated as follows:

	Satisfactory	Unsatisfactory
Intra-abdominal	6	3
Inguinal canal	38	7
External ring	8	5
Total	52	15

Meyer reports 64 cases, in 35 of which the post-operative records were followed. In all the follow-up examinations of these cases the testicle was found to be well down in the scrotum; no case of atrophy, retraction, or hernia was reported.

Among the 31 cases in which the testicle was fixed in the scrotum, Pasten reports good results in 32.26 per cent, fair results in 22.58 per cent, and poor results in 45.16 per cent of the cases. On the other hand, operation by fixing the tes-

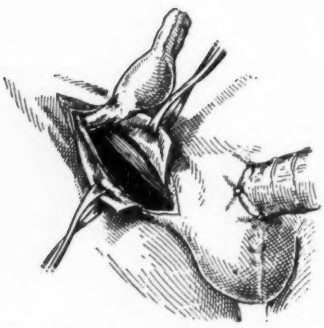

Fig. 1. Transscrotal orchidopexy.[1] The first step consists in the freeing of the testicle.

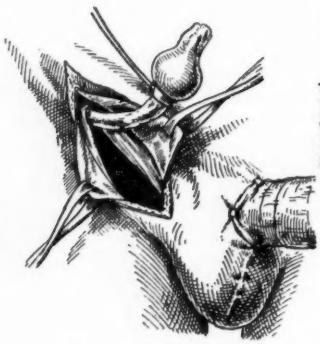

Fig. 2. Second step, traction suture has been placed above the testicle.

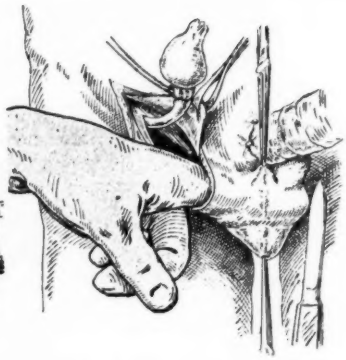

Fig. 3. Third step, hollowing-out of passage into scrotum with finger, and incision of scrotum.

ticle in the upper thigh gave the following results in a series of ten cases: in 70 per cent, good results, in 10 per cent, fair, and in 20 per cent, poor. In the former group the testicle showed development in 20 per cent of the cases, whereas in the latter, development occurred in 60 per cent.

SURGICAL TREATMENT

Unilateral ectopy. An operative procedure on an ectopic testicle may be considered ideal if the integrity of the gland is not sacrificed by gangrene or atrophy and if the testicle is made to occupy the base of the scrotum without tension or discomfort.

Walther has emphasized the value of utilizing the elastic septum of the scrotum, whereas in his series Ombrédanne performs a transscrotal orchidopexy. He has used this operation for 20 years and in many hundreds of cases.

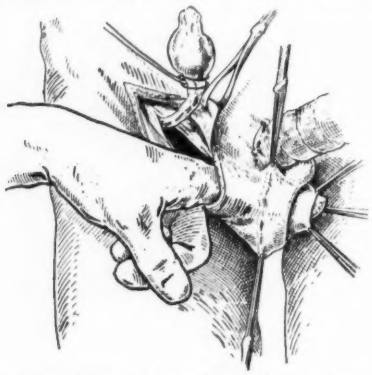

Fig. 4. Fourth step, forceps is attached to finger, to be drawn through the opening in the septum.

[1] The illustrations are taken from Ombrédanne's.

Lowering of the testicle, which at times necessitates the division of the spermatic artery and because of other complications compromises the integrity of the gland, is unnecessary with the technique of Ombrédanne, as in it the septum is brought up to the testicle. Because of the elasticity of the septum the testicle will be found in its normal position within 3 or 4 weeks after the operation.

Ombrédanne's technique. The usual incision for inguinal hernia is made and the anterior wall of the inguinal canal is incised. The cord is then exposed and isolated. The mobility of the testicle may be found to be impaired by a fibro-adipose mass of tissue which tends to draw it in the direction of the bottom of the scrotum. In this mass a peritoneal-vaginal cul-de-sac may be found which may contain the unrolled epididymis; therefore, extreme caution must be exerted to free the bottom of the cul-de-sac without cutting the epididymis or the vas deferens. By gentle dissection the lower extremity of the gland is freed from the adjacent tissue (Fig. 1).

The peritoneal-vaginal canal is then explored. It is usually patent, a condition which may explain the association of an undescended testis with hernia. A radical operation for hernia should be performed at this stage. If the canal is unoccupied by a hernia, obliteration of the canal is unnecessary, as it will close spontaneously after operation when the wall of the inguinal canal has been restored in front of it. However, if we find that the cord is shortened, then by transverse division of the serous peritoneal-vaginal canal and retraction

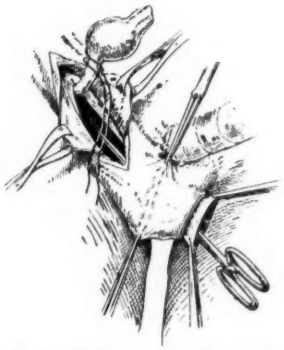

Fig. 5. Fifth step, traction suture is grasped by hæmostat in order to draw testicle into place.

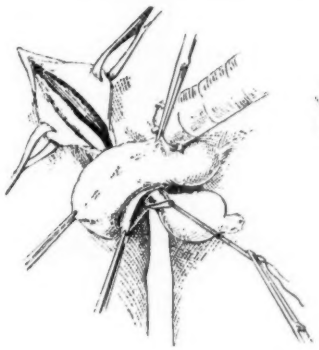

Fig. 6. Sixth step, testicle has been drawn through the septum by means of the traction suture.

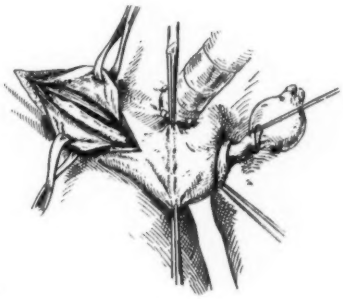

Fig. 7. The seventh step, consists in the partial closure of the opening through the septum.

of one-half of it upward and the other half downward, additional length may be secured which facilitates lowering of the testicle.

A sliding knot is then placed above the gland (Fig. 2) and the testicle is covered with a warm, moist compress.

The scrotal raphé is marked with two Kocher clamps and held gently. Then with the left index finger, beginning at the inguinal incision, a passage is made into the scrotum, progressing toward the middle of the sac diagonally opposite (Fig. 3). Blunt curved scissors may be of aid in the making of this tunnel.

When the elastic septum is reached, it is forced back and the integument of the scrotum on the opposite side is raised. In a case of bilateral ectopy no obstacle will be met; if the ectopy is unilateral, if, for example, the left testicle occupies a normal position and an orchidopexy of the right testicle is being performed, care must be taken that the finger used in making the tunnel elevates the left testicle and presents to the edge of the scalpel only the scrotal integument which overlies the elastic septum of the scrotum. On the side of the scrotum elevated by the index finger, a vertical incision approximately 3 centimeters in length is then made. The incision includes the whole thickness of the integument.

The septum then becomes visible, being recognized by its white color. By means of a compress the two cutaneous lips are pushed back along the finger which is pushing the septum in the inverse direction. By this procedure separation is accomplished and a place for the testicle is secured.

Next, the septum, which has been elevated by the index finger, is pushed back and grasped above and below by two Kocher clamps. The septum is incised vertically between the clamps, thus making it possible for the finger to pass through the septum. In this way a transscrotal passage has been formed from the right inguinal incision to the left scrotal incision. A Kocher forceps is clipped to the tip of the finger (Fig. 4), and the latter is slowly withdrawn, the forceps being drawn with it through the inguinal incision. The free ends of the catgut, the slip-knot of which has been placed around the neck of the gland, are now grasped with the clamp of the forceps (Fig. 5) and brought through the opening in the septum.

If the cord and deferens are sufficiently long, the testicle can easily be brought through the opening which has been made in the septum of the scrotum. If they are too short and the testicle cannot be brought down to the opening in the septum, the opening in the septum must be elevated to the testicle (Fig. 6). This technique of

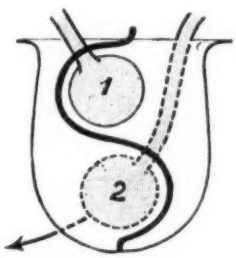

Fig. 8. Bilateral transscrotal orchidopexy (Ombrédanne). Schematic drawing showing relative positions of (1) the testicle which has been lowered into the scrotum in the first operation and (2) the testicle which is being lowered in the second operation.

bringing the septum up to the testicle always renders orchidopexy possible. It is the chief advantage of the transscrotal or Ombrédanne technique.

The opening in the septum should be closed next. Care must be exercised here to make this closure sufficiently tight to prevent escape of the testicle, but not tight enough to cause strangulation. The cord is forced back in the upper commissure of the incision and a suture of linen is placed below it and secured all the way down to the lower part of the button-hole incision, thus assuring hæmostasis (Fig. 7). Ombrédanne does not advise catgut, as it may absorb too rapidly and allow the testicle to escape. Traction on the testicular suture will show whether or not the cord moves freely through the remaining opening in the septum; and traction on the cord in the inguinal canal will make certain that the testicle cannot escape through the opening in the septum. The traction suture about the testicle is then removed by releasing the slip-knot, and the opening into the scrotum is closed.

All that remains to complete the operation is the restoration of the inguinal canal as it is done in the operation for hernia. As the ectopic testicle, which has been thus fixed below the normal testicle, tends to rise, the elastic septum deviates to one side and the testicle occupies a position beside the normal testicle.

Bilateral ectopy. It is seldom advisable to perform a bilateral transscrotal orchidectomy in a one-stage operation by the Ombrédanne technique, although Ombrédanne occasionally advises it if there is an ectopic testicle on one side and a floating testicle on the opposite side or in a case of two floating testicles. Usually, however, there is danger in performing a simultaneous bilateral orchidopexy, even by Ombrédanne's technique, for a band may be produced by the crossing of the cords below the root of the penis, with resultant difficulty in urination because of pressure on the urethra. For this reason Ombrédanne advises the unilateral operation as a general rule.

In a case of bilateral undescended testicles the more difficult side is operated upon first. When the second operation is performed about 3 months later, it is astonishing to see how the testicle which has already been operated upon has increased in size in comparison with the opposite, undescended testicle. In this second operation it is necessary to pass *below* the testicle previously fixed, for at this point the septum can be more easily drawn up about a testicle which occupies a high position (Fig. 8).

Usually no difficulty is encountered at the second operation. Occasionally, however, some difficulty arises when one tries to separate the scrotum from the lower plane in an attempt to secure a cutaneous opening for the testicle. According to Ombrédanne's statement, a sufficient opening can be obtained if the cellular layer is separated gently with curved scissors. In these bilateral cases, a short time after the second operation the testicles are found to be at the same level, especially if the cords are of approximately the same length.

The notable features of Ombrédanne's technique are the following: (1) no interference with the blood supply of the cord and of the testicles is necessary; (2) if the testicle cannot be placed in the base of the scrotum, the septum can be brought up about the testicle, the elasticity of the septum tending within a few weeks to bring the testicle to the base of the scrotum; (3) the septum is the best agent whereby to fix the testicle in the scrotum after it has been brought down into it.

RESULTS

Ombrédanne and his assistants have operated on nearly 900 cases with this technique. Immediately after operation an increase in the size of the testicle is to be noticed. This increase is partially to be explained by the swelling of the tissues surrounding the testicle, but after 3 months this inflammatory condition will have subsided and the size of the testicle itself can be well discerned. In some cases its enlargement is surprising. In cases of bilateral ectopy, in which operation is always first performed on the smaller testicle, when the patient comes back 3 months later to have the second operation, the first, smaller testicle which is now in the scrotum is very often found to be the larger. This is always very convincing proof of the efficacy of the treatment and the parents are very much encouraged.

Of course, such excellent results are not obtained in all cases. Sometimes, when the testicle is not found before operation it is not possible to find it at operation, or some yellow tissue may be the only sign of its presence. But in such a case a splendid iliac gland may be present, with a fairly long cord, waiting before the "closed door" of the inguinal canal. With Ombrédanne's technique it is easy to fix such a testicle in the scrotum.

In other cases the testicle may be found before operation but it may not have the tenderness which is characteristic of the testicle. Froelich's syndrome may be present, and at operation one may find only a very small, soft testicle. Too often such a testicle will not grow after operation. In these cases also one has to deal with a general aplasia, and very little elastic tissue is present in

the undeveloped septum. The septum will also distend secondarily, allowing the testicle to reascend to a certain extent. Sometimes, however, if the ectopy is bilateral, after operation on the second side the second testicle will pull the first testicle down again by means of the septum, so that one may have agreeable surprises in these cases. In any event Ombrédanne's technique seems to be the surest method to prevent recurrence and to secure a good development of the testicle.

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CARCINOMA OF THE MALE URETHRA

With a Technique of Penis Extirpation[1]

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THE occasional occurrence of carcinoma associated with periurethral abscess and similar misleading secondary clinical syndromes again needs emphasis. We should attempt to diagnose earlier this rare neoplasm which is particularly suitable to surgical attack owing to its low degree of malignancy. The discrete local growth, the lateness and rarity of metastases, together with the ease of local removal due to the surrounding anatomical structures, is such that resection gives a high proportion of favorable results except in advanced and unusual cases. The tumor is analogous in its course to bladder carcinoma, although it is more suitable to resection than are most of those tumors. The difficulties encountered with this tumor are mainly those of diagnosis. It is a characteristic tendency of this neoplasm to contract the urethra and to become secondarily infected. In the routine manner of the clinic, the insidious carcinomatous background may be completely overlooked in the treatment of the periurethral abscess and the cancerous stricture.

FREQUENCY

Robb was unable to find a specimen in the museums of the Royal Colleges of Surgeons in London and Edinburgh.

Thiaudiere published the first case in 1834. In 1907 Preiswerk collected 42 cases in the first comprehensive review of this subject, omitting, however, several cases. Since then valuable articles have appeared by Rizzi, Amadeo, Christen, O'Neil, Kretschmer, and Culver and Forster. In a survey of the literature we have been able to find 110 cases on record, excluding doubtful ones such as those reported in Thomson-Walker's text book (insufficient evidence), and those cases of prostatic carcinoma, carcinoma of the penis, and epithelioma developing in fistulous tracts reported in the literature as carcinoma of urethra.

The majority of cases occurred in patients in the cancerous sixth and seventh decades. Paton's case, however, occurred in a boy of 18, Hutchinson's in a man of 22, and Kroiss' in a man of 91.

ETIOLOGY

The exact stimulus for lawless tissue proliferation is at the present time unknown. Many predisposing factors have been described in connection with this particular tumor of the urethra, and as many theories of etiology. Aside from the classic theories of Cohnheim and Virchow regarding tumors in general, gonorrhœa and trauma are most frequently accused. In Rizzi's statistics of 52 cases, a previous gonorrhœa was found in 60 per cent and trauma in 10 per cent. Of Tanton's 65 cases, 26 had gonorrhœa. Christen encountered a history of gonorrhœa five times in 8 cases; Bierbaum, Tizon, Amadeo, and others emphasize this factor. Probable gonorrhœal stricture of the urethra has been described in many cases by Lavenant, Hall, Cabot, Witzenhausen, and others—and traumatic stricture in the cases of Hutchinson, etc. Undoubted origin in a gonorrhœal stricture is reported by Robb. Wassermann, Gayet, Lipman-Wulf, and Platte emphasize the origin of carcinoma in the dilatation of these strictures rather than in the stricture *per se*. Thus the frequent relation of carcinoma to stricture is noteworthy; but the incidence of urethral neoplasm in the strictured and in those with a past history of gonorrhœa is certainly very small, strongly suggesting additional factors of greater importance.

In Kretschmer's and Grunfeld's cases papilloma had previously been removed from the urethra. Shattock was inclined to regard arsenic medication as an etiological factor, and in Kretschmer's case symptoms developed rapidly following the use of Hartzell's (iodine-glycerine) fluid. Culver and Forster's case was scalded by steam. In the case of Olivier and Clunet sex perversion was a possible factor, and in that of Soubeyran the insertion of straws into the urethra. The majority of German authors consider the irritative action of chronic urinary infection an important factor.

PATHOLOGY

The usual lesion is the squamous celled carcinoma with typical pearly-body keratinization. This type occurred in 55 cases of Kretschmer's collection of 80. Columnar celled carcinoma has been reported by Cabot; papillary carcinoma has been described by Buday, Shattock, Englisch, and Kretschmer; adenocarcinoma by Olivier and Clunet. The frequency of urethral squamous celled carcinoma is due probably either to a metaplasia or to embryonal cell-nest inclusions,

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since stratified squamous epithelium in the urethra is normally limited to the fossa navicularis. The epithelium covering old strictures is almost always cornified, stratified squamous epithelium and has been studied by Cedercreutz, Posner, and Halle, who regard it as due to a metaplasia. This epidermidization of strictures is explained by Hubner, however, as due to development through infection and irritation of embryonal nest of squamous epithelium which he describes as existing in the urethra.

The neoplasm is situated more commonly in the perineal and membranous urethra than in the penile; Legueu cites the incidence in the perineal as 63 per cent, Rizzi as 47 per cent. In Romano's case the tumor, which he reports as having arisen in a gland of Littre, was connected to the urethra by a narrow stalk.

The tumor metastasizes late in its course, usually to the inguinal glands. In Allenbach's case it metastasized to iliac glands around the left ureter, to the lungs and liver. Necropsy in Paul's case revealed that the growth was limited to the perineum and neighboring glands. In Montgomery's case necropsy revealed involved pelvic and lumbar glands but no other secondary metastases. In Guiard's case, secondary nodules were found in the lung. No metastases were found in the cases of Amadeo and Griffiths. Death has usually been due to urosepsis.

SYMPTOMATOLOGY

The clinical syndrome varies, depending upon whether the tumor is located in the perineal or penile urethra. Difficulty on urination and infection are common to both forms and are usually present. Hæmorrhage is not infrequent.

Penile. The difficulty on urination is of all grades of severity, including complete retention (Deveze, Bonzani). The penis swells in size (Hutchinson, Scott, and others); and may be cyanotic (Bonzani). Priapism is not infrequent (Olivier and Clunet). Abscess (Conforti) and fistulæ (Menard, Bonzani, and Menocal) are not so common as in the perineal form. A bloody cyst on the under surface of the penis has been described. Pain in the penis may be great (Scott) or absent (Bonzani). The growth may be seen protruding from the meatus (Menard, Deveze, Rizzi, Olivier and Clunet, and Tizon), and the tumor is usually easily palpable (Hutchinson, Olivier and Clunet, Ottow, Bonzani, Hall, Rizzi, Culver and Forster). Urethrorrhagia and hæmaturia are common symptoms (Soubeyran, Shattock, Rizzi, Menocal). Purulent urethral discharge may occur (Ottow, O'Neil, Shattock).

Fig. 1. Gross specimen of amputated penis showing the carcinoma at *C*, destroying the tunica albuginea and invading the corpus cavernosum. Dorsal surface above.

Perineal. The most striking feature of the tumor in this location is the frequency of its association with periurethral abscess. Case after case in the literature reads as follows: gonococcus urethritis; later difficulty, stricture, periurethral abscess, drainage, fistula, biopsy, radical surgery, and cure. Apparently the periurethral abscess is temporarily a successful disguise for this tumor, and an examination of tissue from the abscess wall is not always a routine procedure. The abscess cavity may be filled with blood or friable tissue. The tumor can rarely be felt in the perineum (Amadeo, Montgomery, Romano, and Paton). Urinary infiltration in the perineum was observed by Hall. Severe priapism was observed by Allenbach and O'Neil. Acute retention was seen by Lavenant, Barney, O'Neil, and others. Hæmorrhage between urinations, as well as hæmaturia, is noted by Guyon and many others. A marked œdema of the scrotum and perineum developed in a week in the case of Michon.

THERAPY

Radical surgery should be considered except in cases with hopeless infiltration, since metastasis is rare and late.

For lesions in the anterior third of the urethra, simple amputation of the penis should suffice. For urethral carcinoma between this point and the membranous urethra more extensive removal of the penis with perineal implantation of the urethra is indicated. For cavernous lesions, the entire penis with the crura and urethra down to the membranous urethra should be excised. Emasculation has been frequently performed by European surgeons, but no evidence of the involvement of the testes is available in any of the reported cases, and we believe that it is an unnecessary procedure. In the case of Braasch and Scholl the urethra was excised and later replaced by a transplant of a section of the saphenous vein, with satisfactory results.

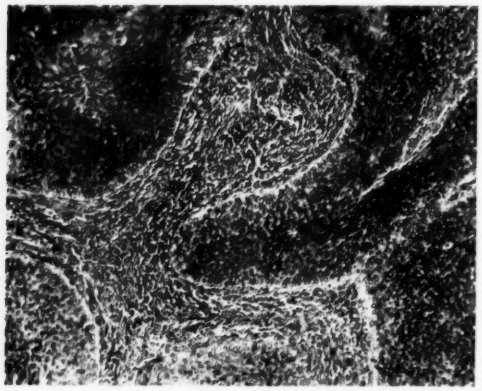

Fig. 2. Section from the deeper portion of the tumor showing the papillary processes and general arrangement.

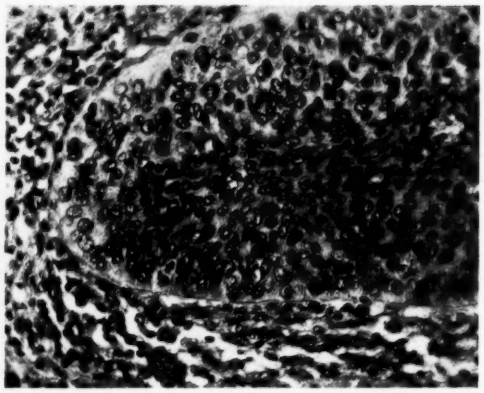

Fig. 3. High power of a papillary process showing cellular structure.

Inguinal glands if involved should be dealt with surgically. Heavy postoperative irradiation of the perineum and the adjacent tissues seems to be indicated in the present state of our knowledge.

COMPLETE EXTIRPATION

The chief difficulty in the operation of total or subtotal removal of the penis lies in the control of hæmorrhage from the erectile tissues and the subsequent identification of the urethra. To minimize this factor we have applied several simple measures, which briefly described are:

As is the common practice, two incisions are made: one longitudinal in the perineum, the other circular around the root of the penis. The transversus perinei muscles are identified. An aneurism needle is then passed between the pubic ramus and the crus penis on each side, anterior to the transversus perinei muscle, and the crus is doubly ligated and cut (Fig. 4). If the crus is ligated posterior to this point, incontinence from nerve injury may follow. A woven filiform is then inserted in the urethra for identification. The bulbocavernosus muscle is split at the decussation of its fibers. The finger may then be easily passed inside this muscle and between the superficial layer of the triangular ligament and the bulb (Fig. 5). Two heavy ligatures are tied around the urethra at the selected point of section and the urethra and filiform are cut. The crura and penis may be easily removed through the anterior incision. After the urethra is identified, the filiform is removed. Hæmostats are so placed as to include the vascular bulb as a whole, and the ligature around the proximal part of the bulb is removed. The erectile tissue may be easily dissected away and the urethra dealt with suitably. The wound is drained, and a catheter *à demeure* is applied.

PROGNOSIS

In Hutchinson's case a slight recurrence followed 3 months after simple amputation; however, the patient was well at least 8 months following simple fulguration. Scott's case was well 10 months after operation. Lippman-Wulf's patient died in an accident 3 years and 9 months after operation. Oberlander's case showed recurrence in the prostatic urethra in 4½ years. Braasch and Scholl's case was alive 5 years after operation; cure not known. Culver and Forster's case was well 6 months after operation. Rizzi reports that 16 of 25 cases operated radically were well 6 months or more after operation. Kretschmer's report 2 years after operation does not mention recurrence.

CASE REPORT

A. C., age 59, French Canadian carpenter, father of 3 children, complained of a walnut-sized lump in the perineum. He had previously been well. Two years before coming to the clinic he awoke one morning with nausea and pain in the bladder and passed blood from the urethra. A slight hæmaturia persisted for 4 days. At this time he noticed a bean-sized nodule in the midline behind the scrotum. A slight occasional dysuria and the gradual slow growth of the tumor were the only symptoms noted until 3 months ago, when difficulty began. On the advice of a friend he procured a bougie 2 months ago which he used several times a day with slight relief. Because he was unable to pass his bougie, he came to the clinic to secure relief from his marked difficulty.

Patient had had a single attack of gonorrhœa at the age of 19 years, otherwise his past history was negative. He showed no evidence or symptoms of stricture.

Examination revealed a hen's egg-sized, indurated, fluctuant, painless mass palpable through the scrotum at

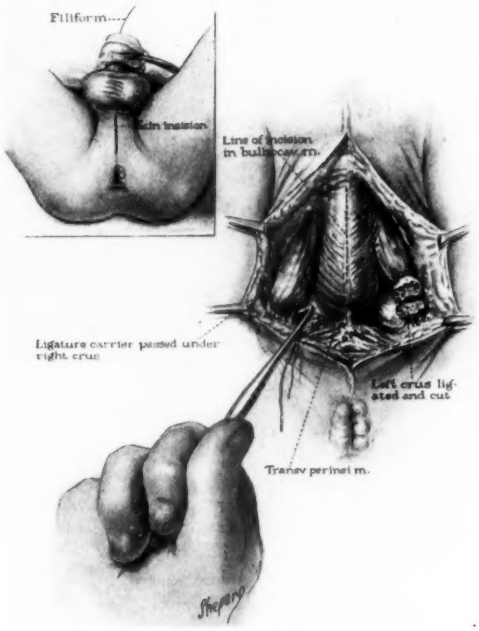

Fig. 4. Preliminary hæmostasis by ligature of the crura anterior to the transversus perinei muscles.

the posterior part of the cavernous urethra, extending into the perineum. The skin was freely movable over the mass, which was not red. Pea-sized, painless lymph glands were palpable in both inguinal regions. The rectal examination was negative. There was a stricture of the urethra opposite the mass, admitting only a No. 6F. bougie. There was a mild generalized arteriosclerosis; otherwise the examination was negative. The urine contained much pus and a trace of albumin. The Wassermann reaction was negative. The patient was admitted to the Albert Merritt Billings Memorial Hospital, where a needle was inserted into the mass and yellow pus was obtained for culture and microscopic examination. Bacteriologically the pus showed streptococcus viridans and staphylococcus aureus. Drainage of the abscess the next morning was not followed by the usual resolution of the inflammation. Instead the mass grew rapidly. Heat was applied to aid resolution of the infection. Three days later urethroscopic examination showed red elevated masses resembling granulation tissue at the site of the stricture. No biopsy was made at that time. Three days later biopsy was decided upon and an egg-sized mass of tissue was removed through the perineal wound. Examination of this tissue showed varying stages of inflammation. Further local treatment of the infection was carried out for 2 weeks, when a second biopsy, including this time the urethral mucosa, showed carcinoma. Radical extirpation of the penis, with section of the urethra 1 centimeter anterior to the triangular ligament, was followed by uneventful recovery. The patient was discharged from the hospital 20 days after operation. At this time, 11 months later, the patient is symptom-free, has gained 35 pounds, and works daily.

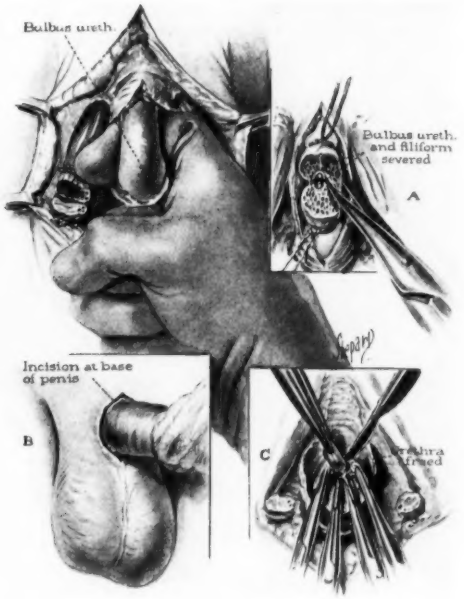

Fig. 5. The cleavage plane between the urethral bulb and the superficial layer of the triangular ligament is shown. Inset A shows the procedure in ligation of the bulb with subsequent section of the erectile tissue and filiform. In inset C hæmostats are applied to the corpus spongiosum. The proximal end of the filiform has been withdrawn and the urethra is being dissected prior to perineal implantation. The penis is removed through the circular incision in B.

PATHOLOGY

Grossly the carcinoma consists of an irregularly ovoid, indurated mass measuring about 4 by 3 by 3 centimeters. It arises from the dorsum of the posterior portion of the cavernous urethra, invades the corpus spongiosum and, destroying the tunica albuginea of the overlying corpora cavernosa, extends into the erectile tissue (Fig. 1). The mass extends posteriorly into the region of the urethral bulb and perineum. This portion is nodular, and within it are multiple abscesses containing a thin greenish pus. The indurated mass completely surrounds the intact urethra. The urethral mucosa is slightly hæmorrhagic and presents no evidence of stricture. In cut section the carcinoma is cartilaginous in consistency, granular in appearance, and of a grayish color.

Microscopically the sections reveal a squamous celled carcinoma with a moderate amount of keratinization and some epithelial pearl formation. There is a severe surrounding inflammatory

reaction, including acute abscess formation. The urethral epithelium in the involved region is thickened and sends many papillary processes down into the underlying submucosa (Fig. 2). Many of these have an intact basement membrane (Fig. 3) but others have none, and isolated cells and cords of cells are seen extending into the adjacent submucosa. Many of the folded processes may have a core of vascular connective tissue or even desquamated cells and necrotic tissue. Throughout, the sections reveal a severe inflammatory reaction of varying degrees and ages. The submucosa of the adjacent urethra is œdematous and invaded by leucocytes. The inflammatory and carcinomatous process involves the erectile tissue of the corpus spongiosum, the tunica albuginea, and the erectile tissue of the corpus cavernosum.

SUMMARY

This case demonstrates the following important points: (1) that the course of the lesion is indolent; (2) that urethral carcinoma can cause periurethral abscess and stricture, which are clinically indistinguishable from the usual variety of primary types; (3) that biopsy, to be effective in the diagnosis, must include urethral mucosa; (4) that an apparently good result has been obtained from radical surgery.

It demonstrates that biopsy by means of the urethroscope should have been carried out and suggests, since the pathology is mucosal, endoscopic removal of tissue in similar suspected cases. Urethroscopic findings have been reported by Grunfeld, Christen, and Oberlander.

CONCLUSIONS

1. Carcinoma is associated with a small percentage of periurethral abscesses and urethral strictures.

2. Urethral carcinoma is rather low in the scale of malignancy and is well adapted to surgical treatment.

3. Biopsy, which should include the urethral mucosa, is the only certain method of diagnosis.

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Further bibliography may be found in Preiswerk (49).

FASCIA LAPPING AS APPLIED TO THE TISSUES OF THE VAGINAL WALL—A MISNOMER

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LAPPING of the tissues of the anterior vaginal wall for the correction of cystocele and prolapse of the uterus has engaged the attention of gynecologists for the past 11 years. My interest in this field began at its inception, and it was my impression in common with others then that there existed in the tissues used a definite layer of fascia which was derived from the intra-abdominal fascia. The technique which I adopted differed from others, however, in that it did not aim to utilize this fascial layer as a separate entity but to use it undisturbed with all the other structures of the anterior vaginal wall. The initial step and one of the essential features of my technique is a direct transverse incision of the anterior wall, immediately above the cervix into a cellular area bounded by the cervix, bladder, and anterior wall. I found in following this procedure that this cellular area is a well defined space in which the bladder, cervix, and anterior wall are but loosely connected and that when a definite cystocele exists this loose connection extends to the base of the urethra, and in case the cystocele is extensive this loose connection is found to extend laterally also.

In that my previous studies of the fascial relationship in the pelvis led me to believe that the visceral layer, a ramification of the intra-abdominal fascia, delved down between the bladder and the anterior vaginal wall, I concluded that the superior surface of the separated anterior vaginal wall constituted, in cases of cystocele, the visceral fascial layer, and that when this pathological condition existed, the visceral layer lost its intimate relationship with the bladder wall and remained an intricate part of the anterior vaginal wall. Eight years ago I doubted the correctness of this idea and began a series of studies of the tissues removed during the course of my operations for all forms of vaginal prolapse. These studies have convinced me that the tissue which I have been considering fascia is not fascia, or if fascia, it has undergone some pathologic change and as found, could render, when isolated, whether doubled or quadrupled, no serviceable support if used in the process of reconstruction for correcting any form of vaginal prolapse.

Figure 1 is a drawing of a piece of tissue (1½ by 3 inches) removed from the left side of the freed longitudinally and medianly incised anterior vaginal wall. This piece of tissue was removed during an operation to reconstruct the anterior vaginal wall for the cure of a very large cystocele and shows the characteristic smooth under surface. The lower border was severed from the region of the cervix. The right border represents the line of the median, longitudinal incision. The left border represents the line of incision which severed this section of the wall from its lateral attachments. The remaining lateral portion of the vaginal tissue on this side was eventually used as the overlapping tissue in the formation of a supporting shelf for the bladder. The apex of the triangle represents the region at the base of the urethra.

Figure 2 is made from a microscopic study of a cross section of the tissue through its center seen in Figure 1. This structure consists chiefly of the muscle fibers of the vaginal tube, blood vessels,

Fig. 1. Tissue removed from anterior vaginal wall.

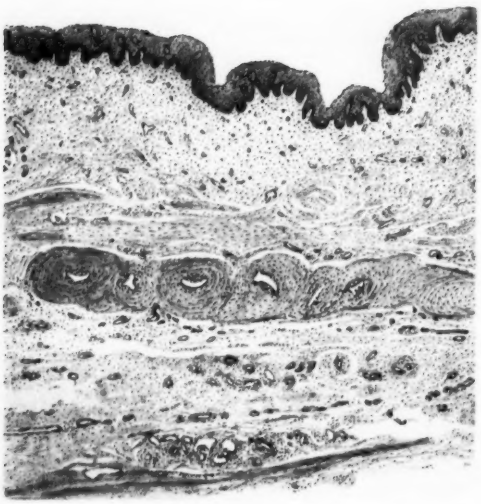

Fig. 2. Photomicrograph of tissue in center of specimen shown in Figure 1.

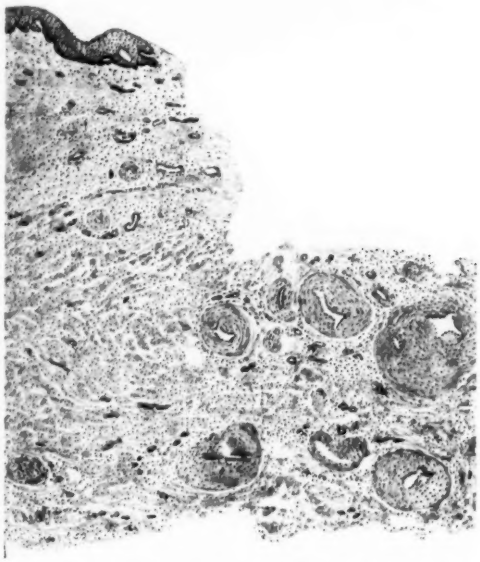

Fig. 3. Photomicrograph of cross section of tissue after removal (at right) of mucosa and submucosa leaving part used to form flap for reconstruction of shelf to support bladder.

and loose connective tissue with mucous membrane and cellular tissue above; no fascial layer is demonstrable.

Figure 3 is made from a microscopic study of the cross section of the corresponding piece of tissue shown in Figure 1. The part on the right side from which the mucosa and submucosa have been removed represents the tissue which is utilized to form the under flap when the shelf, upon which the bladder is to be supported, is constructed. This piece of tissue also consists chiefly of muscle structure and blood vessels in which no fascial layer can be demonstrated, and upon it the entire muscle tissue of the vaginal tube on the opposite side is placed and anchored doubly to strengthen the support created for the bladder. These are two of 25 or more studies I have made of different cases. It might be here incidentally noted that the posterior and anterior vaginal walls are structurally the same.

CONCLUSIONS

In cases of vaginal prolapse there is no definite fascial layer of the vaginal wall which can be isolated and used surgically to advantage.

The musculature of the vaginal tube constitutes the chief resisting tissue of the tube.

The strength of the normal vesicovaginal septum consists of the intimate union of the muscle tissue of the walls of the vagina and the walls of the bladder.

To correct a cystocele, the anterior vaginal wall must be completely separated from the bladder so that a new union can be established between the musculatures of these walls and so that the vaginal wall will be doubly strengthened by the lapping of its musculature.

As there is no definite fascial layer demonstrable in the vaginal structure lapped, the term fascia lapping is a misnomer.

As a corollary, the etiology of cystocele is the loss of complete and intimate muscle union of the bladder and vaginal wall; in this loss of union each structure is compelled to resist separately and in so doing fails to maintain its normal position.

THE USE OF SECONDARY SUTURE IN CIVIL PRACTICE

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IN spite of the splendid results obtained during the Great War with secondary closure following the Carrel-Dakin treatment of wounds, many surgeons have almost completely abandoned the procedure in civil practice. Our experience with it has shown us that it is an important adjunct in the treatment of wounds, and we think it should not be discarded. We wish to point out in this brief review the types of cases in which the method may be used, the technique, and the results. As is well known, the method consists in the attempt to sterilize an open wound by the use of antiseptics, and after a sufficiently clean field has been obtained to close the wound by suture.

We consider the following types of wounds suitable for secondary closure:

1. Infected traumatic wounds, especially those of the extremities in which débridement and primary closure is inadvisable, because the débridement, if sufficiently extensive, would cause serious mutilation. By comparatively simple débridement, combined with the Carrel-Dakin treatment of the wound, several additional inches of an extremity may be saved for the patient, and the subsequent secondary closure gives a good functional stump. Even in the cases in which a relatively clean amputation at a higher level is done, we frequently close the fascia only, leaving the skin open. This is done because many such wounds closed primarily break down and have to be opened widely later. This is especially true in cases in which a tourniquet has been applied for some time before surgical intervention is possible and is probably due to lymphatic extension upward from the contused and infected tissues.

2. Amputation wounds of infected extremities, such as infected compound fractures, gas bacillus infections, badly infected gangrenes, etc.

3. Infected incisions, i.e., wounds which had been previously closed, become infected, and have been reopened.

4. Wounds resulting from the incision and drainage of abscess cavities.

The wounds easiest to close are ones which are relatively deep and narrow. With broad, shallow wounds, closure could be done only by extensive undermining, and it is probably better to cover such wounds with skin grafts rather than undermine widely to effect a closure. In some cases it may be advantageous to close the major portion of a wound and cover the remainder with grafts.

The method we have used is virtually the same in all cases. We use Dakin's solution almost exclusively as the sterilizing agent, applying it either through tubes, or by means of compresses which are changed every 4 hours. In very extensive wounds we have occasionally used Pilcher's solution[1] because protection of the skin is not necessary with it, and the care of the wound is therefore much simplified. However, Pilcher's solution does not sterilize a wound as does Dakin's solution, and it is usually necessary to use the latter for at least 48 hours immediately preceding the closure.

It is made as follows:

Quinine sulphate	1.00 gm.
Hydrochloric acid	0.50 c.cm.
Glacial acetic acid	5.00 c.cm.
Sodium chloride	17.50 gm.
Formol (40%)	1.00 c.cm.
Thymol	0.25 gm.
Alcohol (90%)	15.00 c.cm.
Water q. s. ad	1 litre

(1) Dissolve quinine in hydrochloric acid and acetic acid
(2) Dissolve sodium chloride in water
(3) Dissolve thymol in alcohol

Add (1) to (2), then add formol, then add the solution of thymol in alcohol.

The solution is bactericidal, non-irritating, stable, and moderately deodorant. It has no proteolytic properties.

The decision as to when the closure should be done depends on clinical judgment combined with laboratory confirmation. The former is based on the appearance of the wound, and the general condition of the patient. The wound itself should appear healthy, with firm, red granulations, and with comparatively little exudate. In greatly debilitated patients it may be necessary to spend weeks or even months in improving the general state of the patient's health. In wounds associated with osteomyelitis, one may be forced to wait for sequestra to separate, etc. Laboratory confirmation is obtained by the examination of smears and cultures from the wound. If a stained smear, made from the exudate in the dirtiest portion of the wound, shows less than 3 or 4 bacteria in ten oil-immersion microscopic fields, it is considered safe to close the wound. If the Dakin's solution is continued long enough, the wound can generally be made sterile to culture.

The technique of the closure is important. For 12 to 18 hours immediately preceding the suture

[1] This solution was described in Ann. Surg., 1926, lxxxi, by Major J. T. Pilcher.

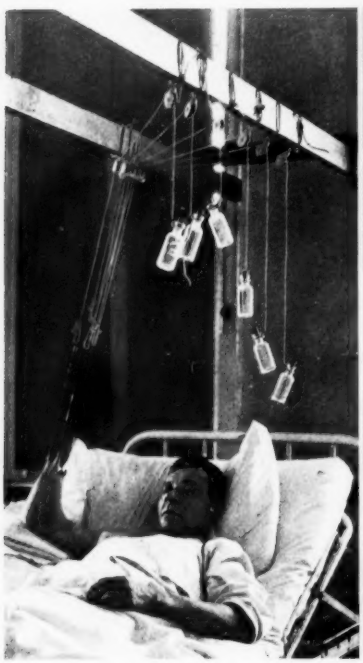

Fig. 1 (left). Method of traction by weight and pulley.
Fig. 2. Close-up of same patient as shown in Figure 1.

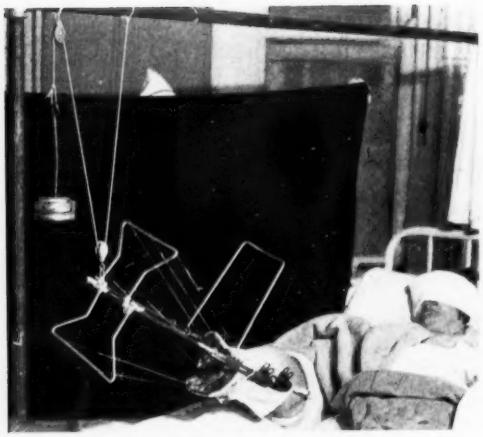

Fig. 4. Amputation for gas bacillus infection after compound fracture. Traction by means of rubber bands.

Fig. 3. End-result in patient shown in Figure 1.

Figs. 5 and 6. Same patient as shown in Figure 4 showing sutures in place and end-result.

Fig. 7.

Fig. 8.

Fig. 7. Gas bacillus infection of chest wall following stab wound. The wound left after incision and drainage.

Fig. 9.

Fig. 10.

Figs. 8, 9, and 10. Same patient showing sutures in place and end-result.

irrigation of the wound with Dakin's solution is carried out every 2 hours instead of the usual 4 hours and is continued to the last minute. The skin edges are very carefully cleansed with benzene and then with alcohol, or with soap and water and then alcohol. Any secretions are then washed from the wound with sterile salt solution or blotted off with dry gauze. Frequently we wash the entire wound and surrounding skin by pouring ether over it. The skin edges are painted with tincture of iodine. For small wounds, local anæsthesia is used; for larger ones, gas or ethylene. The edges of the skin are then freshened by cutting away the thin margin of new epithelium. Undermining of the skin edges is used only if necessary, and every care is taken to avoid traumatism to the granulating surfaces. Bleeding is controlled by hot packs if possible, for it is unwise to bury much ligature material. The closure is then made by the placing of interrupted deep sutures of silkworm gut or of silk and tying them loosely. These are usually placed 2 to 2.5 centimeters apart so as to allow for drainage between them, for drains are seldom necessary or desirable. The skin approximation must not be too exact, because provision must be made for some escape of exudate between the sutures. The cleaner the wound, the more exactly may the skin be closed.

Of great value in providing closure without undue tension on the skin is a planned procedure in the original operation. For example, in amputations, when the level can be elected, a cuff of skin, or anterior and posterior flaps can be reflected and sutured to the skin above in their reversed position. This gives a wound easy to dress and prevents excessive contraction of the skin. In guillotine amputations or in other wounds in which insufficient skin is present, more may be made available by the use of traction. Various forms of obtaining and maintaining traction have been devised, but our most satisfactory results have been with weight and pulley traction applied directly to the skin by means of wire sutures placed in its edge. These sutures are given a broader bearing surface when the ends of the wires are tied to ordinary bone buttons which are allowed to pull on the skin. The best weights we have found are small bottles, which can be filled with water or with lead shot to give the

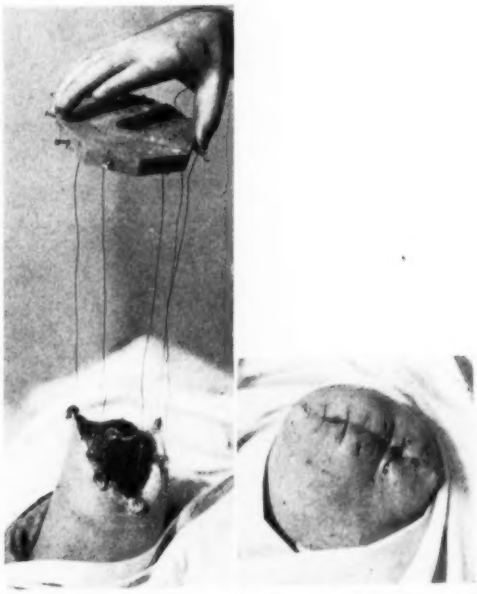

Fig. 11 (left). Amputation for severe infection following open reduction of compound fracture.

Fig. 12. End-result in patient shown in Figure 11.

Fig. 13 (left). Amputation for gas bacillus infection in compound fracture. Sutures in place.
Fig. 14. End-result in patient shown in Figure 13.

Figs. 15 and 16. Method of closing fascia and reflecting cuff of skin. Dakin's compresses are applied until the surface is sterile, then the skin is turned back and closed. Side view of same stump.

desired pull. During 1926 and 1927 on the surgical service at the Cincinnati General Hospital, 49 secondary closures were performed with the following results:

	No.	E.	G.	P.	F.	Left hosp.
Partial traumatic amputations	8	7		1		
Amputations for infection, etc.	10	8	1		1	
Infected incisions and abscesses	27	21	3	1	1	1
Empyema, chronic	3	2	1			
Excision of infected tumor	1	1				
Total	49	39	5	2	2	1

E., union as satisfactory as any primary union.
G., satisfactory union with some small granulating areas.
P., only partial union or large granulating areas.
F., no union and the wound opened widely.

Left Hosp. means one patient left the hospital the day the closure was done, and the end result is unknown to us.

Further analysis shows:

	Number	Per cent	Per cent
Excellent	39	79.59	= 89.79
Good	5	10.20	
Poor	2	4.08	
Failure	2	4.08	
Left hospital	1	2.04	

One of the poor results was in a large tuberculous abscess secondarily infected, the other in an amputation stump with insufficient skin. One of the failures was in an infected incision, the other in an arteriosclerotic patient with diabetes.

The average time between the last operation and the time of closure in 42 of the 49 cases was 13.1 days. The 7 cases excluded are 3 cases of chronic empyema, 2 cases of chronic osteomyelitis, 1 case postponed for more than a month because of poor physical condition, and 1 case in which the time was not recorded.

CONCLUSIONS

1. Secondary closure is a valuable procedure.
2. The procedure is not used as extensively as it should be.
3. It is of particular value in certain types of cases: (a) traumatic amputations, (b) amputations for severe infection, (c) for closing infected wounds and abscess cavities.
4. The procedure gives better functional results than does skin grafting.

HÆMANGIOMA OF KIDNEY

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A RECENT report by Judd of a case of angioma of the kidney recalled to us a patient who was operated upon at the Presbyterian Hospital for a similar condition and whom we have followed for 10 years since his operation. The fact that Judd found only eleven reported cases seems to warrant the addition of this one to the literature. It is the only case of hæmangioma in the records of the Presbyterian Hospital. The symptomatology was that which would be expected in a bleeding renal neoplasm. The diagnosis of kidney tumor was made by the usual urologic methods. The treatment, which in this patient resulted in cure, was nephrectomy.

History No. 39264. A young married Jewish peddler, aged 37 years, entered the hospital September 24, 1918, complaining of pain in the back and right side and blood in the urine. He had had typhoid fever at 10 years of age and malaria at 30. He was well until 9 months before admission, when, after doing some heavy lifting, he was suddenly seized with a sharp, stabbing pain in the right lumbar region, which radiated to the right testicle and the inguinal region. Three hours later he passed a large amount of bloody urine with some clots. He continued to show blood in the urine for 3 or 4 days. He remained in bed for 9 days, when he again passed bloody urine, but this time there was no associated attack of pain. From then until his admission, he had several attacks of hæmaturia, all of short duration.

Physical examination revealed a round, slightly tender mass in the right upper quadrant of the abdomen, which moved on respiration. X-ray examination of the kidney region was negative. Cystoscopic examination showed a normal bladder except for several blood clots, one of which was seen to be emerging from the right ureteral orifice. The left ureteral orifice was normal. Clear urine was obtained from the left ureter; bloody urine from the right. Both specimens were negative for tuberculosis. Pyelography, which was not a routine procedure in those days, was not done. Blood urea was 31 grams per litre. Blood Wassermann was negative for the alcohol antigen, three plus for the cholesterol antigen.

The diagnosis of renal neoplasm was made, and on October 3, 1918, right nephrectomy was done by Dr. Squier.

The kidney on gross examination was normal except for a rather adherent capsule and a slight enlargement of the entire organ, with a moderate dilatation of the pelvis.

Pathological examination of the gross specimen shows a kidney, 12 by 6 centimeters. Upon one surface is a smooth shiny capsule with a few fine adhesions which are present also on the most of the antero-exterior surface. From the middle anterior portion of the antero-external surface there is a more or less lobular tumor, about 6 by 6 centimeters. At three different places there are bluish elevations on the surface which appear intimately attached to kidney tissue. The tumor as a whole is cystic and slightly fluctuating. The pelvis of the kidney appears slightly dilated. The ureter appears normal. The kidney capsule strips with great ease but leaves the surface slightly granular. At several places the capsule is discolored bluish black by what appear to be old areas of hæmorrhage. Upon palpation of the pelvis

Fig. 1. Gross specimen showing kidney and tumor.

Fig. 2. Kidney bisected, showing tumor involving pelvis.

Fig. 3. Section has been made through the tumor mass.

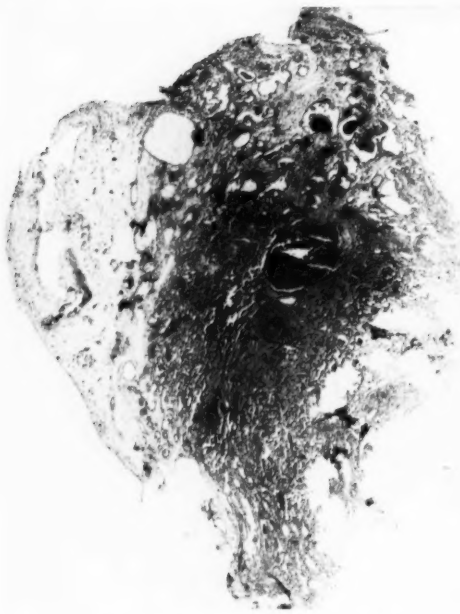

Fig. 4. Low power microscopic section.

there is felt a soft movable object within; section discloses this object to be a blood clot, which appears slightly organized, fitting into the contour of the pelvis. There is fluid blood in other parts of the pelvis. The surface marking of cortex and medulla appear about normal. No calculi are found. Cut section of the tumor shows a definite, fibrous capsule enclosing many irregularly shaped cavities likewise surrounded by fibrous trabeculæ. The contents of the cavities appear to be old clotted blood. The tumor appears to have risen within the kidney substance and upon its growth to have expanded the kidney capsule, which now forms its covering. The growth extends into the pelvis, but no communication is seen explaining the bleeding into the pelvis.

Microscopic examination shows that the capsule of the tumor is of fibrous tissue, smooth on one side, and ascending in from the deep surface, thin trabeculæ extend into the formation of the blood vessels of the various channels. The substance of the tumor is made up of various sized spaces filled with red blood cells (some are empty). The spaces are lined with a single layer of more or less flat cells. In these thin trabeculæ are a good many round cells. The kidney tissue shows mainly rather marked parenchymatous degeneration and edema.

Diagnosis: cavernous hæmangioma of kidney.

The postoperative recovery was uneventful. The patient has returned regularly for follow-up appointments, and when last seen on April 19, 1928, 9 years, 7 months after operation, was in good health, still working as a peddler, and was free from symptoms.

Fig. 5. High power microscopic section, showing spaces filled with red blood cells.

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TUMORS OF THE PARATHYROID GLANDS

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IN the last 25 years much investigative work has been done and a great many articles written on physiology and pathology of the parathyroid glands. Comparatively few articles, however, discuss the presence or possibility of tumors of these glands, although Sandstrom, who first recognized and described the parathyroids as independent organs, pointed out that they could be interesting to the clinician and pathologist if they formed the matrix of tumors. Because such tumors may be confused with thyroid neoplasms, and because a study of them may help to clarify our knowledge of the function of these glands it seems justifiable to report the following case, and to review the literature on the subject:

A native born white woman, age 29 years, entered the Cook County Hospital, January 2, 1926, with the examining room diagnosis of adenoma of the thyroid. Her main complaint was a swelling of the neck for 5 years. She stated that she first noticed a small lump about the size of a "marble" in the left side of the neck 5 years before, and 6 months after giving birth to her first child. The mass had gradually grown larger, especially in the last 2 years, but had remained localized on the left side only. At or before her menstrual periods she experienced shooting pains across the neck on exertion, associated with dizziness and a choking sensation. The latter symptoms had appeared on various other occasions but usually only with menstruation. She had noticed a nervous irritability in that she became easily excited and wept on slight provocation, and at such times would tremble so severely that she was forced to sit down and rest. She believed that during these attacks she had a "staring gaze" and prominence of the eyes. For the past month or two excessive perspiration had been noticed. During the past 2 years exertion or excitement caused palpitation of the heart with dyspnœa, and for 1 year there had been slight dysphagia. She had been married 8 years and pregnant three times. The first pregnancy miscarried for unknown reasons, the latter two resulting in normal healthy children. Her history was otherwise unimportant.

Physical examination revealed a well nourished, quiet and co-operative woman with normal temperature and respirations, and a regular pulse of 72. The blood pressure was 112 systolic and 72 diastolic. The palpebral fissure seemed slightly widened but the eye findings were otherwise normal. There was no tenderness or abnormal pulsations in the neck; but in the region of the left lobe of the thyroid there was an orange-sized, round, coarsely lobulated, firm mass without tenderness or fluctuation. The right lobe of the thyroid seemed slightly enlarged. The heart borders, rate, and rhythm were entirely normal, and there were no other noteworthy physical findings. The blood Wassermann was negative. Her basal metabolic rate was 4 degrees negative. She was quite comfortable, and on January 6 was operated on under ether anæsthesia by E. J. Lewis. He found a mass in the side of the neck behind and below the left thyroid lobe which was adherent to and compressed by it. The tumor was covered by a fibrous capsule, was fairly well demarcated from the surrounding structures, and was removed with little difficulty. Her pulse rate reached 116 after operation, but during her stay in the hospital was usually between 80 and 90. On January 18, her basal metabolic rate was 1 per cent negative, the wound healed nicely, and she was discharged in excellent condition.

The laboratory report was as follows: This specimen consists of an oval, fairly smooth tumor mass about 8 by 6 by 4 centimeters, and apparently covered by a fascial sheath except over one surface (Fig. 1). The tissue is generally elastic and resilient, and adherent to it are gray fibrous tags. Surfaces made by cutting revealed a yellow to gray, gelatinous medullary portion 3 to 4 centimeters in diameter in the center of the tumor. This is irregularly traversed by white, firm, fibrous strands which extend out into the surrounding tissue in finger-like processes. One portion of the gray tissue near the center is definitely cartilaginous in consistency, and in this is a 2 millimeter gray-white nodule which is calcified. The surrounding tissue or cortex of the tumor measures from 1 to 1.5 centimeters in width. It is a bright yellow to gray, lobulated in portions, and striated by white, yellow, and red streaks. Numerous cystic cavities varying from 2 to 8 millimeters in diameter are scattered throughout all portions of the tumor. These are thin-walled with gray or yellow linings with contents varying from a pink mucoid fluid to blood. In one large one the blood is clotted and adherent to the wall. Irregular areas of blood are present in the capsule and tumor mass, in some places forming hæmatomata, in others being more a diffuse and infiltrating hæmorrhage. Small opaque bright yellow soft spots up to 2 millimeters in diameter are scattered throughout. In no place is there any tissue resembling thyroid parenchyma, nor any gross evidence of colloid. The capsule where present is intact, apparently of fibrous tissue, and is not invaded by the tumor.

Microscopic sections, stained with hæmatoxylin and eosin, and made from the central portions of the tumor, revealed a fibrous network, pink staining and devoid of nuclei, in the meshes of which are masses of a granular débris, and hæmorrhages. Here also are spaces about which the connective tissue is dense and hyaline, and which are filled with the ghosts of erythrocytes. More peripherally nuclei appear in the stroma, the above mentioned spaces are seen to be well formed blood vessels, and masses of tumor tissue are recognizable. From the central core, radiating processes branch out to fuse with the capsule, thus separating the tumor into masses and cords which are generally well demarcated except medially where the tumor cells merge gradually with and seem to give rise to the central fibrous and degenerated structure. The tumor cells are apparently epithelial in type, spindle shaped, closely packed together with a finely granular or pale pink cytoplasm, and large dark, round or oval nuclei. The nuclei are distinct and rich in chromatin, but contain no nucleoli. Mitotic figures are occasionally seen. In many areas the cells lie side by side in a palisade arrangement; elsewhere they are in no definite order (Fig. 2). In the latter areas the tumor cells tend to be more nearly oval or polygonal, but occasionally they are cuboidal and form a single layer lining a narrow channel. The small epithelial lined ducts thus formed are either devoid of contents or contain a granular material, but no blood. Another type of space seen is much larger, elongated, and is found in bizarre,

Fig. 1. Tumor of parathyroid gland (actual size—formalin fixed specimen). The differentiation between the cortical glandular portion and the fibrous medulla is easily seen. A blood filled cyst can be noted in the upper right quadrant.

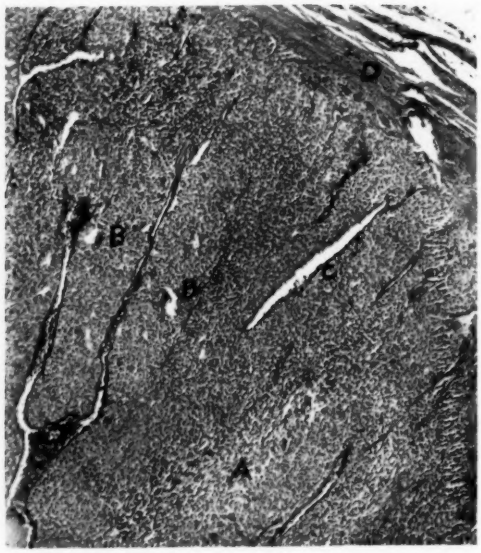

Fig. 2. Low power photomicrograph of cortex of primary tumor. The palisade arrangement of the tumor cells can be noted at *A;* the epithelial lined ducts at *B;* blood vessels at *C;* and the capsule at *D.*

branching forms. These are also present in the interlobular septa from which they extend into the tumor tissue. They are lined with a single layer of flattened cells and many of them have thick, fibrous walls. Most of these are empty, while others contain varying amounts of blood elements, some being packed with erythrocytes and giving the appearance of true capillaries. A few are dilated into cysts which are grossly visible. In some areas recent hæmorrhage has replaced the tumor cells or crowded them together.

The capsule varies from a loose areolar structure to a dense hyalinized fibrous tissue, and contains many large, thin-walled blood vessels similar to those mentioned in the tumor.

Sections taken from along one side of the tumor revealed atrophic thyroid parenchyma which is stretched out in the areolar tissues of the capsule. The alveoli are small and contain only a small amount of colloid, and areas of undifferentiated thyroid epithelium and of round cells are seen. In some places the tumor masses closely approach the thyroid tissue, but nowhere in the tumor itself is there any evidence of thyroid epithelium. In a few places there are nests of tumor cells in the capsule but none such are demonstrable in the lymphatic or vascular spaces, and the general impression is that we are dealing with an encapsulated benign tumor which is undergoing retrogressive changes.

In the capsule near one pole of the tumor is a soft gray area about 4 by 3 by 3 millimeters which reveals the microscopic structure of normal parathyroid tissue. It is covered by atrophic thyroid acini, and medially goes over into the tumor tissue previously described, suggesting that the tumor is of parathyroid origin (Fig. 3). It is made up of cells generally larger than those of the tumor, and with clear homogeneous cytoplasm which varies from a pale gray to a rather bright pink. The nuclei are generally dark staining and eccentrically placed, occasionally they are vesicular and centrally located in the cells which have the pale cytoplasm. All of these cells are separated by a fine fibrillar stroma and are arranged in nests or anastomosing, tortuous, rather narrow cords separated by numerous thin empty spaces lined with endothelium. These resemble the "rosarote" type of chief cells of the normal parathyroid (Fig. 4) described by Getzowa and Aschoff. The "water pale" type of chief cell is probably represented by the pale staining rather larger cells noted. Nowhere in the tumor were found the characteristic "oxyphilic cells" with eosinophilic staining granules, nor were syncytium-like cell groups observed. Where this normal parathyroid tissue goes over into the tumor mass there are a few small alveoli lined by parathyroid epithelium and filled with a homogeneous substance with the staining properties of colloid. This was the only place where such were found.

Fat stains made with Sudan 3 reveal scattered orange red bodies in the tumor parenchyma particularly in the medial portions of the lobules. These are both intracellular and extracellular, and many of them are seen in the degenerated central portions of the tumor. In a few areas they are packed in clumps corresponding to the deep yellow nodules seen on gross examination of the freshly cut surfaces of the specimen. Unfortunately because of formalin fixation sections stained for glycogen were unreliable.

The pathological diagnosis was "adenoma of a parathyroid gland."

Attempts to follow up this case had been unsuccessful when it was decided to report this tumor; but on November 5, 1926, the patient unexpectedly returned to the hospital because of the presence of three nodules which had developed near the operation scar. She stated that she had a slight sense of constriction in her neck at times, but no dysphagia nor dyspnœa. Her nervousness had disappeared, and her only complaint was the unsightliness of her neck. The tumor on the left side had been noticed one week after returning home following the operation in January. She was uncertain as to the time of appearance of the others

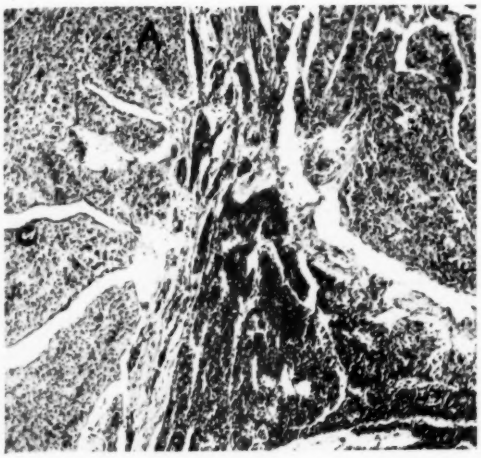

Fig. 3. Parathyroid tissue in capsule of primary tumor. Normal parathyroid tissue *A* going over into tumor tissue at *B*. The thin walled endothelial lined spaces are well shown at *C*.

but believed that they had been gradually enlarging. Examination revealed three non-tender lumps, each about 1.5 centimeters in diameter just beneath the skin but protruding prominently (Figs. 5 and 6). Two of these were on either side of the neck 4 centimeters apart, equidistant from and at about the level of the thyroid cartilage. These were firm and not adherent to the skin. The left was somewhat fixed to the deeper structures, the right freely movable. Over the medial end of the left clavicle was a smaller but similar nodule over which the skin was somewhat reddened. The scar of the operation was well healed with some cicatricial contracture of the tissues below. There were no other glands palpable in the neck. Her general health was excellent, and there was no evidence of bone disease nor of the presence of tumor metastases. Blood calcium study revealed 8 milligrams per 100 cubic centimeters, a normal amount.

Because of the characteristic location of two of these nodules the conclusion was that these probably represented a compensatory hyperplasia of the remaining parathyroid glands following the removal of the adenoma, although the possibility of metastases from an originally malignant tumor was considered. On the assumption that we might be dealing with a patient with an abnormal demand for parathyroid secretions, she was put on desiccated parathyroid extract by mouth and told to return in 2 weeks.

On December 1, she returned, and during the preceding 3 weeks there had occurred a definite increase in size of all three nodules. They were still freely movable, but for diagnostic purposes the one over the clavicle was removed under local anæsthesia. It was quite vascular, friable, gray to yellow in color, and poorly desiccated in the surrounding soft tissues.

Microscopic sections stained with hæmatoxylin and eosin and made from this specimen reveal an entirely different picture (Figs. 7 and 8). The individual cells still bear a resemblance to those of the primary tumor, but there is marked variation in size and shape and chromatin content. Mitotic figures are abundant. The palisade arrangement is nowhere to be seen and the cells are grow-

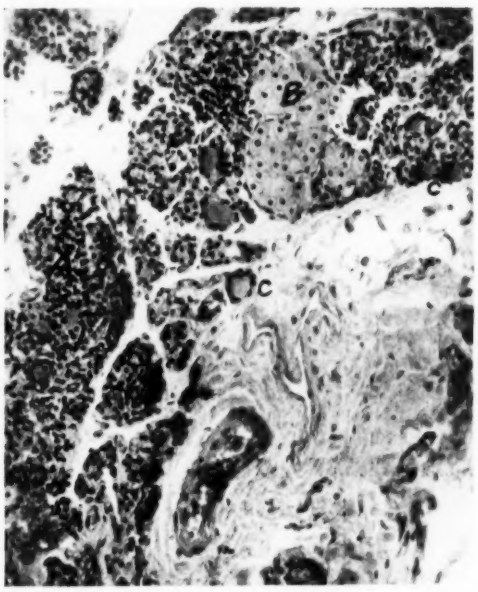

Fig. 4. Normal parathyroid gland from an adult male of 45 years dying of lobar pneumonia. The chief cells are shown at *A*, and the oxyphilic cells at *B*. "Colloid-like" droplets surrounded by parathyroid epithelium are seen at *C*.

Fig. 5 (left). Three recurrent nodules on November 5, 1926, 11 months after the removal of the primary tumor. The scar of the operation is well shown. The two upper nodules are at the sites of the superior parathyroid glands.

Fig. 6. Showing size of recurrent nodules on November 5, 1926, 11 months after the removal of the primary tumor.

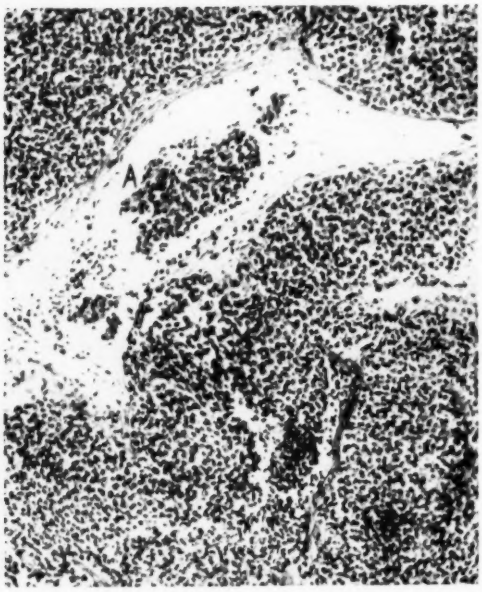

Fig. 7. Low power photomicrograph of recurrent nodule. The malignant nature of the growth is here indicated in the variation in the individual cells, the mitotic figures, and the invasion of the lymphatic space at *A*.

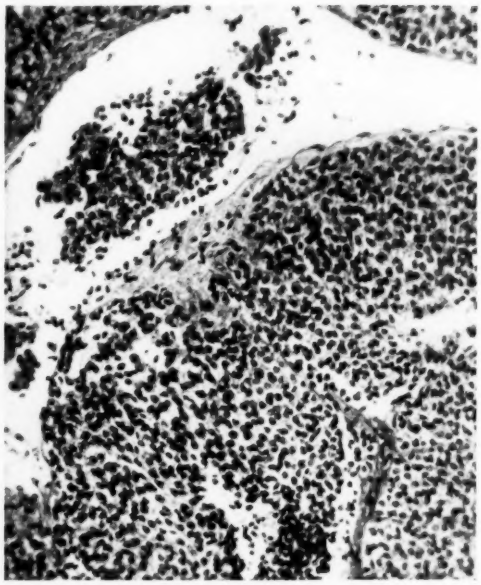

Fig. 8. High power photomicrograph of the same field as that shown in Figure 7.

ing in lawless profusion. They are seen infiltrating the surrounding soft tissues and growing into the endothelium-lined spaces in which they are found in masses as shown in the illustration. Such an infiltrative type of growth was entirely absent in the sections of the primary tumor. No alveoli lined with tumor cells are found in the recurrent nodule. The picture is that of a malignant tumor of epithelial origin which is apparently growing rapidly.

The patient re-entered the hospital in January, 1927, and resection of the other nodules was performed under ether anæsthesia. Dr. Lewis found and removed also two other small tumors of a suspicious nature in the left posterior cervical triangle. Microscopic sections of all these reveal essentially the same picture as that of the above, that is, a diffuse carcinoma of a highly malignant character. Healing of the wound was slow, and deep X-ray therapy was instituted February 15. In July the nodule over the clavicle had recurred and grown to about 2 centimeters in diameter, and there were two other small tumors palpable in the anterior cervical triangles. Her general health was fairly good and there was no evidence of pulmonary or other metastases. In May, 1928, the masses were much larger and the one over the clavicle was ulcerated through the skin and bleeding. She had received in all, about twenty deep therapy X-ray treatments, apparently without benefit. She had lost weight and there was evidence of pulmonary metastases. She left the city so her further course could not be followed.

There are many aspects of this case which merit discussion, but no attempt will here be made to consider parathyroid functions or to review the immense amount of literature on that subject. The three nodules which appeared as described within a year after operation were at first thought to represent compensatory or adenomatous hyperplasia of remaining or aberrant parathyroid tissue in the neck. Thompson and Harris have studied the presence and locations of parathyroid tissue in a series of routine autopsies, and whereas four main glands were usually found at the four poles of the thyroid, aberrant parathyroid tissue at other sites was discovered. Millzner has more recently made similar observations. While the two upper nodules were in the typical locations of the two superior glands, the lower one over the clavicle was considered as a possible aberrant nodule such as have been noted by these authors and others. Against this conclusion it was argued that there were no signs of parathyroid insufficiency following the removal of the primary tumor, and such signs might be expected if the patient's demand for parathyroid secretions was sufficient to cause a compensatory hyperplasia of the remaining glands.

In spite of the gross and microscopic indications of the benignity of the primary tumor and the absence of any recurrences at its site, the weight of evidence warrants the conclusion that we were dealing with a primary malignant tumor of para-

thyroid origin, which possibly started as an adenoma, and that the three nodules represent metastases.

Search of the literature reveals few references to primary malignant tumors of the parathyroid glands. Hendriock has recently reported a case of a tumor 8 by 5 by 4.5 centimeters removed surgically from a retrosternal position in a woman of 71 years. This mass was largely surrounded by thyroid tissue, and there was also present a much smaller intrathyroid tumor nodule. The larger tumor was yellow, well demarcated from the thyroid and surrounding structures except at one area, with fibrous septa extending into and dividing it into lobules, as in our case. The smaller tumor was less than 1 centimeter in diameter and was located at the upper pole of the thyroid gland, while the larger mass was in the lower pole. Histologically the tumor cells resembled parathyroid tissue and the palisade arrangement was frequently noted. Intracellular fat was demonstrated by the Sudan and osmic acid methods. In the larger mass oxyphile cells were absent, the tumor was invading the thyroid gland, and there was a departure from the physiological structure with distinct proliferating centers and the formation of giant cells. For these reasons Hendriock concluded that he was dealing with a malignant tumor arising from the interior parathyroid of this side and invading the thyroid parenchyma. He admitted that the absence of mitotic figures and of metastases spoke against this conclusion. The smaller nodule he believed to have arisen from the upper parathyroid and considered it probably an adenomatous enlargement of an intrathyroid rest rather than a metastasis from the larger tumor. There is unfortunately no record of further examination of his patient.

Fasiani reports the surgical removal of a fist-sized nodular mass in the region of the left thyroid lobe. The patient was a woman of 45 who stated that the mass had "always" been present but had recently and rapidly increased in size. The operation was done under local anæsthesia and the patient died on the table for unexplained reasons. No autopsy was performed. The specimen was round and nodular, and definite evidence of invasion of the thyroid gland was present on both gross and microscopic examination. Histologically the tumor consisted essentially of (1) cellular protoplasmic masses staining with hæmatoxylin and without definite cell boundaries, (2) cords and masses of larger well defined fairly clear cells, and (3) cords of chromophile staining cells resembling normal parathyroid tissue. The first two types made up the bulk of the tumor, and the author believed that cells similar to these are also found in the normal parathyroid.

The case here reported is comparable to Hendriock's and Fasiani's in several respects, and probably all three tumors arose from parathyroid tissue in its normal location. Histologically the three are quite similar, except that I found no invasion of the thyroid gland.

In 1909 DaCosta briefly reviewed the literature on the subject of parathyroid neoplasms, and added one case which is most interesting in comparison with my own. DaCosta's patient was a woman of 32 with a mass in the right side of the neck which had been present for over 6 years. It had started following an attack of tonsillitis and had grown rapidly for the last 2 years. The patient suffered from choking attacks and an irritating cough for 3 years, and was thin, pallid, and neurotic. The mass was overlapped by the sternocleidomastoid muscle and was smooth and firm. It was removed and the patient made an uneventful recovery. The specimen was brown-yellow, irregular, and with a bulb-like, softer, darker walnut-sized mass inferiorly. The main mass was surrounded by a fibrous capsule, and consisted microscopically of epithelial cells arranged in fairly distinct columns separated by vascular intercellular tissues. Acini lined by cuboidal cells were noted. The nuclei of the cells were spherical and rich in chromatin. Areas of recent hæmorrhage and degeneration were seen, and there were many bands of fibrous tissue in the tumor. The pathological diagnosis was hyperplasia or adenoma of a parathyroid gland. The most interesting feature of the case was that the patient returned 9 months later with an exactly similar mass, both in size and location, on the opposite side of the neck. This, Dr. DaCosta refused to remove because of the danger of tetany.

This may have been an instance of compensatory hyperplasia of the remaining parathyroid tissue, although a malignant growth was not excluded. The marked hyperplasia of the remaining glands, if such was the case, presumably resulted from the same excessive demands for parathyroid secretion which caused or was associated with the original tumor formation. That such a hyperplasia occasionally results following thyroidectomy has been observed experimentally (Aschoff), and may be due to the accidental removal of functioning parathyroid tissue.

Because of the presence of thyroid parenchyma in the capsule of our tumor, the question may be raised as to whether we are dealing with a tumor of the thyroid or of a parathyroid rest, instead of one developing from a normal gland. The evi-

dence is against the former conclusion inasmuch as the microscopic structure at once suggests parathyroid origin both because of the individual cell morphology, and the arrangement. As far as we know, no true tumors of the thyroid present this picture, and in it can be demonstrated what appears to be the transition of normal parathyroid to tumor tissue. It is true that oxyphile cells are absent, and this has been the case in others previously reported. This patient's symptoms on her first admission suggest a possible thyrotoxicosis but are not diagnostic, in spite of the recovery following the first operation.

Aberrant parathyroid tissue or rests in the thyroid gland have been noted by Michaud, Getzowa, Erdheim, and others. Langhans and Kocher reported malignant parathyroid tumors developing in the thyroid gland, but Harbitz as well as Aschoff is inclined to interpret these cases as tumors of the latter tissue primarily.

Kolodny recently reported a thyroid specimen removed from a woman of 68 who had symptoms of exophthalmic goiter. The gland had white well circumscribed nodules of clear large anastomosing cells containing abundant lipoidal droplets and glycogen. These he interpreted as metastases from a hypernephroma, but admitted the absence of evidence of a primary tumor or of other metastases. He does not mention the possibility of these tumors having developed as adenomata from parathyroid rests in the thyroid, but this seems highly probable, and Hendriock goes so far as to say that Kolodny's case is the first one reported in which the evidence is apparently sufficient to make this diagnosis. Ewing mentions the similarity between hypernephroma and parathyroid rests.

That the tumor in my case might have arisen from a parathyroid rest in the thyroid cannot be denied, but it had the typical location of one of the normal glands and was not apparently intimately connected with the left thyroid lobe. The incorporation of thyroid tissue in the capsule of one side can be explained by this organ being compressed and atrophied by the growing tumor. Thus a review of the literature reveals no one unquestionable case of parathyroid neoplasm developing from an intrathyroid rest, although there seems to be no histogenetic reason why this cannot occur.

In attempting to collect the reported cases of true tumors of the parathyroid glands, one is impressed by the frequency with which this diagnosis has been made on insufficient evidence. It is also difficult to separate the true tumors from the cases in which the enlargement of the parathyroids is so small and uniform that it seems probable that a hyperplasia only existed. Of the latter some of the cases discussed in the papers of Strada, Todyo and Hohlbaum, Weichselbaum, Molineus, and Harbitz may be mentioned. Some of these enlargements were associated with paralysis agitans, rickets, osteomalacia, and osteoporosis; but the significance of parathyroid changes in these diseases is doubted by Molineus and Harbitz.

There have been described, however, several undoubted cases in which a parathyroid gland enlargement was found which must be interpreted as true adenoma formation. One such instance of adenoma of the parathyroid removed by operation has been reported. Benjamins in 1902 described the successful removal of a tumor the size of a child's head which had grown rapidly in a man of 57. The mass was surrounded by a capsule in which normal parathyroid gland tissue was found. Microscopically the substance consisted of broad strands and masses of epithelial cells like those of the normal parathyroid. Toward the connective tissue stroma were palisade rows of cells, and occasional colloid droplets were seen. There were no metastases from the tumor and the patient recovered.

In 1908 Thompson and Harris described a large tumor 15 by 10 by 6 centimeters which weighed 250 grams and was surgically removed from a woman of 23. It had been growing since infancy and involved both lobes of the thyroid. It was encapsulated and firm, the capsule dipping down between nodules up to 4 centimeters in diameter. There were a few gelatinous cysts. Histologically the cells resembled parathyroid tissue, lying in nests and cords, and generally cuboidal or columnar. In some areas the cells lined simple ducts which became dilated to form cysts. The blood supply was good but large blood vessels were absent, a fact the authors particularly emphasized. They came to no definite diagnosis in this case, simply referring to it as a "parathyroid-like tumor."

Goris in 1905 made the diagnosis of cystic degeneration of a parathyroid gland on a tumor removed from the neck of a 22-year-old male. It was composed of three cysts closely connected but independent and without attachment to the thyroid. Microscopically it revealed encapsulated colloid and degenerated parathyroid tissue.

De Santi in 1900 reported a large vascular tumor of the thyroid (?) removed at operation from a man of 58. The description is inadequate and all that is mentioned is that there were pressure symptoms of dysphagia, hoarseness, and cough; and that the gland was found microscopically to

consist of parathyroid tissue. None of the above mentioned tumors reported by Thompson and Harris, Goris, and De Santi can be unquestionably accepted as parathyroid neoplasms.

Adenomata of the parathyroids have been an incidental finding at autopsy in several instances. MacCallum in 1905 described a tumor mass 2 centimeters in diameter removed from the neck of a man of 26 who died from nephritis. This was below but separated from the lower pole of the thyroid. Microscopically it showed strands and anastomosing branches of clear cells containing no granules. Small groups of cells taking a deep eosin stain and resembling the normal oxyphile cells were seen also. It differed from the normal gland only in bulk, size of cell masses, formation of cavities, and absence of fat. Two other normal parathyroids were found, so MacCallum concluded that this was probably an adenomatous new-growth. If, however, it represented a work hypertrophy he explained it on the basis of renal insufficiency making extra demands on the parathyroids, although he did not elaborate on this hypothesis.

Hulst also in 1905 reported the postmortem findings in the body of an old man who died of accident. The thyroid was atrophic and on the right side was a brown-yellow encapsulated tumor of a parathyroid gland measuring 2.5 by 2.5 by 2 centimeters. Histologically it consisted of nests of polygonal cells and the palisade arrangement was noticeable in parts. Small droplets of colloid were present between the cells and about the capillaries. The pathological diagnosis was hyperplasia or adenoma of the parathyroid gland.

Weichselbaum in 1907 reported finding a tumor of the upper part of the left thyroid gland in a woman who died from pneumonia. It was 4.3 by 3 by 5 centimeters, soft, movable, and red-gray, and without evidence of malignant change. Histologically several types of cells were present including normal parathyroid and oxyphile cells, aggregations of radially arranged cells about central lumina, and undifferentiated masses. The tumor contained no fat, and the diagnosis between adenoma and hyperplasia could not definitely be made. In the discussion following the presentation of this case, Askanazy stated that he had seen a similar parathyroid tumor in a patient with osteitis deformans, and he raised the question of the possible connection between the two diseases.

Verbitz noted at autopsy a diffuse hyperplasia of one of the parathyroids measuring 2.5 by 1.75 by 1.5 centimeters which showed a new-growth of epithelial tissue and oxyphile cells regarded by him as adenomatous. Erdheim and Bauer found an adenoma of one of the parathyroids in a woman of 45 who died of nephritis and who had a moderate degree of osteomalacia.

Harbitz reported three cases. In a woman of 26 who died of osteomalacia and tuberculosis, he found an oval tumor 3.5 by 3.5 by 2 centimeters adjacent to and below one lobe of the thyroid, and corresponding exactly with the location of one of the parathyroids. Harbitz believed that this was an adenoma but admitted that "the cells did not closely resemble the glycogen containing (chief cells) of the normal parathyroid, which cells are similar to those of the adrenal cortex and hypernephromata." His second patient died from arteriosclerosis and chronic alcoholism, and there was a history of paralysis agitans. The autopsy revealed two tumor-like bodies, the largest of which measured 2.5 by 2 centimeters, which corresponded with the inferior parathyroids in location. Microscopically there was no real glandular structure, and the cells were in compact anastomosing rows. He concluded that these tumors were too large for a hyperplasia and interpreted them as adenomata. Harbitz's third case was a woman of 32 who died of pulmonary tuberculosis 4 weeks after childbirth. At the lower left pole of the thyroid was a yellow-white encapsulated mass 11 by 5 centimeters. This tumor was made up of densely packed epithelial cells, divided into lobes by connective tissue septa. In the capsule were elongated nests of parathyroid cells which supported the author's belief that this was a true adenoma. In all three cases the tumor cells took a definite eosin stain, but in none of them were oxyphile cells seen.

Erdheim reported a tumor removed at the autopsy of a patient 18 years old. He did not state the sex. The specimen measured 2.5 by 1.5 centimeters and was at the lower pole of the thyroid but not definitely connected with it. The structure consisted of irregular masses of cells among which were colloid droplets, but definite follicle formation was lacking. No other parathyroids were found, so the conclusion favored was that this represented a work hypertrophy rather than a true tumor.

Strauch's case was similar to Erdheim's in that no other parathyroids were found, and the author concluded that the growth resulted from excessive functional demands. His tumor was removed from the neck of a woman who died after a typical attack of puerperal osteomalacia. It measured 4.5 by 3.2 by 3.5 centimeters, and was made up of pale rose-colored cells, eosinophile cells and other normal elements of the parathyroid; and Strauch believed that the presence of all of the normal

elements supported the compensatory hyperplasia conclusion, and disproved the idea that this was a true adenoma, for he claims that only one type of cell is found in the latter. He also believed the tumor growth to be the result rather than the cause of the osteomalacia.

The manner of embryological development of the parathyroids is quite generally agreed upon by several authors, but there has been some difference of opinion as to the normal histological structure. Thompson and Harris studied the glands in 250 routine autopsies and arrived at some definite conclusions. They determined the fat content to be constant in adults and mentioned that the distinct yellow color therefrom was of value in the gross differentiation of the glands from other small neck organs. Erdheim, Kaufmann, and Gierke have found intracellular fat in the normal parathyroid irrespective of the nutrition of the individual and have mentioned that this increases in amount with age.

Thompson and Harris found colloid when present at all to be widely distributed. They identified colloid in 14 per cent of their cases and considered it as normal in individuals over the age of 20. They remarked that when found it may make the parathyroid look a great deal like thyroid tissue in some areas, but that this should not be confusing. They discredited any relationship between these two organs on embryological, physiological, or anatomical grounds.

Tumors of the parathyroids are discussed in general by several authors. Ewing in his textbook mentions both benign and malignant tumors of the parathyroid glands, and malignant growths arising from rests in the thyroid. He discusses several distinct cell types which may be present in these tumors, i.e.: (1) columns of opaque epithelium often arranged in palisade form and also forming alveoli; (2) large clear cells with dense cell borders and cytoplasm rich in glycogen; and (3) groups of strongly adicophile cells. He speaks of the frequency of large blood spaces and of canals lined by columnar epithelium, and the difficulty of differentiating from thyroid tissue when colloid is present. Both he and Harbitz realize the difficulty in deciding between a moderate diffuse hyperplasia of the parathyroid and a true adenoma of that organ.

Gierke believes the adenomata consist predominantly of glycogen containing elements resembling the chief cells, whether they arise from the glands themselves or from intrathyroid rests. He also mentions the possibility of the latter possessing malignant properties. Histologically he describes several cell types in the normal parathyroid. The epithelial cells are: (1) chief cells which are either small with dark nuclei and pale granular eosinophilic protoplasm ("rosarote sellen") or "water pale" cells with a foamy poorly staining protoplasm; and (2) oxyphilic cells with variable eosinophilic granules. The latter type lie in groups and are particularly found in old people. The water pale cells contain most of the glycogen and show an increasing fat content with advancing age. He also noted inconstantly both between the cells and in follicles a "colloid-like" material which he thought was due to delayed resorption, and does not believe that there is as yet known any histological evidence of increased activity. Getzowa has essentially the same classification for the cells of the normal parathyroid; but he emphasizes the presence of slit shaped spaces, lined either by endothelium (lymphatics) or epithelium (the chief cells), or due to the degeneration of the glandular parenchyma.

CONCLUSIONS

1. Adenomata of the parathyroids are comparatively rare tumors.
2. No unquestionable case has been reported in which a tumor developed from a parathyroid rest in the thyroid gland.
3. Apparently benign tumors, of years' duration, may suddenly take on malignant characteristics.
4. The question of true adenoma formation or of hyperplasia may be difficult to decide in cases of enlargement of the parathyroid glands.
5. Parathyroid tumors can be differentiated from those of thyroid origin, but the two may be easily confused.
6. The connection between neoplasms of the parathyroids and diseases of the bones is not definitely known.
7. Compensatory hyperplasia of the remaining parathyroids after removal of one or more of the glands probably may occur rapidly and without apparent symptoms.
8. Histologically tumors of the parathyroids may vary considerably in the predominance of cell types.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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APRIL, 1929

PRODUCTIVE HOSPITAL WORK

OUR surgical and medical activities now center about hospitals. In most of our communities, the efficiency and progressiveness of the hospital work give a fair indication of the type of surgeons and physicians located there. Real efficiency in hospital work calls for high grades of devotion and ability in the members of the two governing bodies, the managers and the medical board. The holding of a position on either of these boards should entail serious responsibilities.

The managers frequently have very great difficulty in providing the funds for carrying on the work of the institution properly. Their duties cannot be performed efficiently unless they have some source of income, unless they have a fair degree of wisdom in determining the policy of the institution, and unless they can work in close sympathy with the members of the medical board for the success of the hospital.

The medical board must provide for the professional work of the hospital. If each doctor can gain eminence in a useful department of his work, the success of the hospital is practically assured. There are multiple examples of the benefits which have come to hospitals through the success of the members of the attending staff. These outstanding men, often handicapped at first by inferior facilities, have had the vision, the industry, and the ability which has brought real achievement, and the institutions in which they have worked have reaped a large share of the benefit. Hence, when we talk of "productive hospital work," we naturally think of notable achievements by the members of the staff of the hospital, and we wish to establish the kind of organization which best encourages such accomplishment.

There has been an evolution in professional work which has corresponded somewhat to the developments in the industrial world. The entire output of individual forges, small isolated blast furnaces and factories scattered throughout the land, was far less than the present output of the United States Steel Corporation. Automobile production, transportation, and other industries abound in similar examples of efficiency; which show that well organized effort is far more productive than unorganized effort.

Organization of the work in hospitals has progressed along similar lines. The hospital where many men are snatching bits of time from private practice and where they are each devoting these snatched moments to about the same kind of work, cannot be expected to have a high grade output.

Our most productive hospitals are those which are organized on the basis of a wise directorship, conjoined with groups of efficient workers who have opportunities for develop-

ing special kinds of work and gaining eminence in them. This means co-operation—but co-operation is the essence of modern development. If the doctors have appreciated this and have contributed fair amounts of properly directed effort, they have prospered marvelously; if they have failed to do so, they usually have dragged along in mediocrity.

Successful organization of this type has certain fundamental requirements:

1. The directorship may be in the hands of one man or of a group of men, but it must be broad-minded and generous, it must avoid unwise activities which are based on ignorance or prejudice, and it must aim to provide the best available opportunities for each group of workers.

2. The groups of workers must make efficient use of the opportunities for training which the hospital gives; there must be a "trying out" process for surgeons, physicians, and executive and nursing staffs which corresponds to Nature's rather cruel method of the "survival of the fittest." Any staff member who expects the hospital to carry him should soon be put in the "discard."

Those who consider hospital work less important than private practice which is not related to that work, or social or sporting activities, or business speculation, and those who are fundamentally untrustworthy or lazy should not expect to be successful.

3. There must be a vital *esprit de corps*, a certain idealism, a sense of loyalty to the institution and to each other. Each patient must be given a "square deal," fair consideration, and careful, skillful attention.

4. The members of the staff should have educations so broad and judgment so correct that the concentration of individual effort will not lead to unwise procedure. Each physician and surgeon should have a judicial grasp of the broad fields of medicine and surgery.

5. The hospital authorities and the profession at large justly expect contributions to the advancement of scientific knowledge. Those who have exceptional opportunities for observation have corresponding obligations to give some of the benefits of these observations to others. It is unthinkable that there should not be something worthy of record where a large mass of clinical observations is properly made.

6. The work should be done primarily on a humanitarian basis. It is the pride of the profession that this is true. But in comparing our activities with those in other callings, we must note the growing, broad-minded human interest which is evident in the industrial world. We may remember Mr. Charles Schwab's recent statement to the effect that the future of industry will depend less upon developing new machines than upon developing the management of men on a human basis.

I have an abiding faith in the general superiority of the members of our profession and do not wish to find some time that there is a greater proportion of broad-minded co-operation in the business world than in ours.

CHARLES N. DOWD.

CURETTAGE PRECEDING HYSTERECTOMY

DURING recent years, attention has been directed by several well known surgeons to the frequent development of carcinoma in the cervical stump after supravaginal hysterectomy. Polak, in 1920, collected 256 cases in America in which cancer occurred in the cervical stump after subtotal hysterectomy for fibroid tumors. Cases in which cancer developed within one year of hysterectomy were not included in his list, on the supposition that in such cases the disease was co-existent at the time of operation.

Cases in which there is strong clinical evidence that cancer existed at the time of supravaginal hysterectomy and was overlooked are perhaps equally numerous if not more so.

Ample statistics gathered from various sources seem to show an incidence of cancer associated with fibroid tumors of the uterus of above 2 per cent.

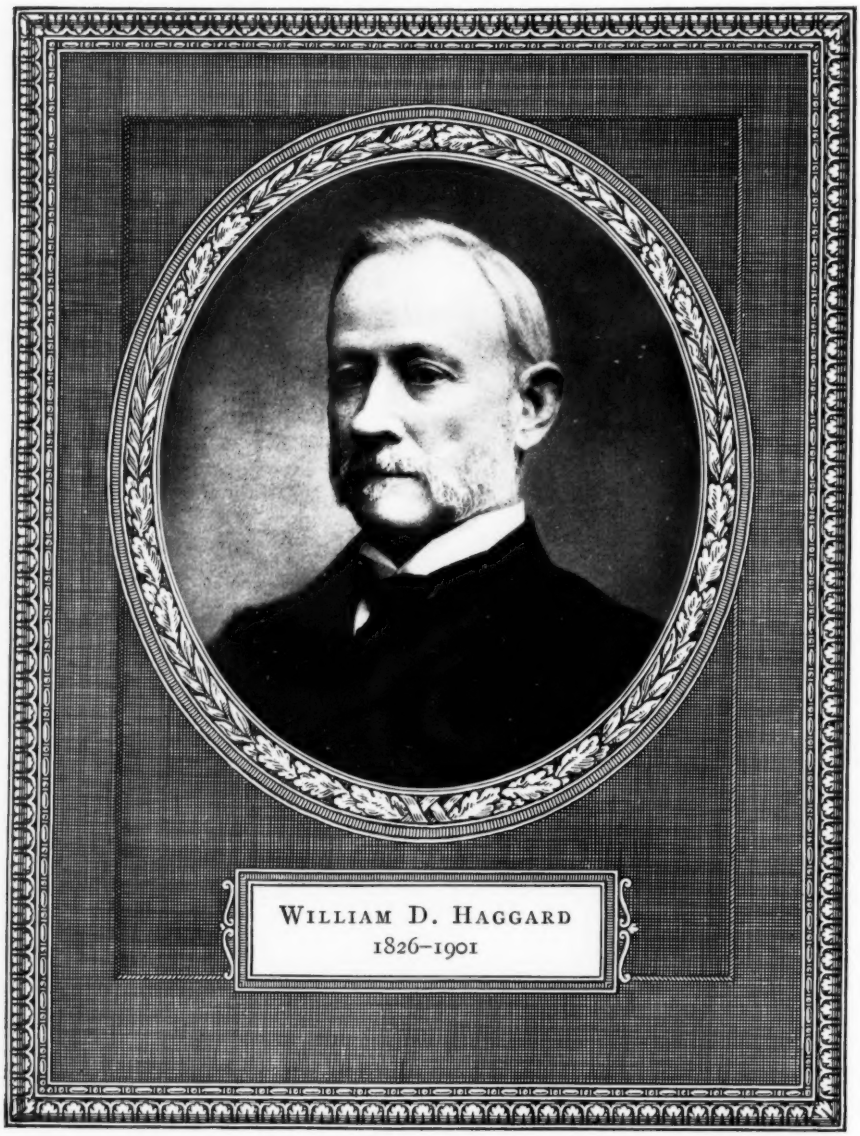
A few years ago, in reviewing the records of the Massachusetts General Hospital for five years, I was able to find eight cases of cancer of the cervical stump following supravaginal hysterectomy for fibroid tumors. The original operation had been performed elsewhere in one-half of these cases. In four cases signs and symptoms of the disease followed so soon after the operation as to make the presumption unescapable that cancer existed at the time of the original operation. It is interesting to note that in three of the eight cases the patients were single women in whom, therefore, the trauma of childbirth played no part in the etiology.

The recognition of this cancer problem in connection with supravaginal hysterectomy has led to the advocacy of various expedients for its solution. A few well known surgeons have advocated total hysterectomy as a routine procedure in operating for fibroids, except in nulliparous patients when the cervix is free from injury or disease. However, it is felt by most surgeons that such a radical stand on the part of the average operator would be likely to lead to an operative mortality higher than the incidence of the disease itself. Other leading surgeons advocate as a less radical procedure, the coring out of the cervical canal with the knife or the cautery. While undoubtedly somewhat quicker and perhaps attended with fewer sequelæ than total hysterectomy, this technique cannot to my mind be considered desirable if cancer already exists in the uterine canal, nor can it be considered a preventive of cancer subsequently developing in the portio vaginalis, as sometimes happens.

No routine measure can adequately meet the situation; each case must be considered individually. The frequent association of cancer of the body of the uterus or of the cervix with uterine fibroids should be borne in mind whenever operation is contemplated.

The cervix should be inspected and palpated with care previous to operation and a biopsy done if malignancy is suspected. If the cervix is a badly lacerated, eroded, and inflamed organ, total hysterectomy is, of course, indicated. Even if the cervix appears innocent, and supravaginal hysterectomy seems to be the operation of choice, it is my firm conviction that a preliminary curettage should be done in every case immediately preceding the laparotomy. If the curettage is negative, no harm is done and only a few moments of time has been consumed, and one may proceed to supravaginal hysterectomy with a clear conscience. If there should be a coexistent carcinoma of the body of the uterus or of the cervical canal, the curette will reveal its presence clinically, I believe, nine times out of ten. If the curette finds a soft spot in the wall of the uterus from which much friable tissue is obtained, while elsewhere the normal scraping sound and feel is elicited, such a suspicious circumstance would warrant an immediate total hysterectomy, even if confirmation by microscopical examination of fresh tissue is not available to the operator. Of course, the availability of such expert laboratory guidance in doubtful cases is most desirable.

This use of the curette will, I believe, reveal carcinoma of the uterus clinically in practically every well developed case and will permit of a more intelligent decision between total or supravaginal hysterectomy than can otherwise be obtained. LINCOLN DAVIS.



WILLIAM D. HAGGARD
1826–1901

MASTER SURGEONS OF AMERICA

WILLIAM DAVID HAGGARD

A PIONEER surgeon of the early abdominal era; a virile, inspiring, and long remembered teacher of surgery; one of the founders and the first president of the Southern Surgical Association; an able and unusually active practitioner for fifty years in Tennessee, William David Haggard of Nashville died January 25, 1901. He was the eldest of the ten children of Ezekiel E. and Malinda Haggard and was born at New Market, Marion County, Kentucky, October 17, 1826. His forbears emigrated from Albemarle County, Virginia, with a company of some two hundred in the latter part of the Eighteenth century. They crossed the Alleghanies and took up lands near Lexington. In this community they founded at Winchester the first Baptist Church west of the mountains. The records of Salem Church for 1799 contain the minutes of a meeting in which the grandfather of Dr. Haggard, with this same given name, was the moderator in trying one of the members before courts were established.

Dr. Haggard was educated at the Academy at Lebanon, Kentucky. Early in life, he evinced the rare energy of his parents and cherished the ambition to become a physician. When he was eleven years of age, his father died of malarial fever. The slaves on his river bottom plantation were given quinine, which was just being used tentatively. They recovered. The master was given the old preparation of cinchona bark but died after a fortnight's illness, at the early age of 38. The son devoted himself to the affairs of the farm and assisted his mother in freeing their property from encumbrance. He then taught school and afterward became tax assessor of Marion County at the age of nineteen. He continued these occupations until he had earned enough money to give himself a medical education.

He entered the office of Dr. Shuck at Lebanon to "read medicine" in 1847. After a year's preliminary reading he took his first course of lectures at the University of Louisville. The next year he followed his professor of surgery, Samuel D. Gross, to Philadelphia when Dr. Gross was called to Jefferson Medical College from the University of Louisville. The fine Kentucky horse which was ridden to Philadelphia, when sold, paid his tuition and keep for this college year. Others of the faculty at that time were Meigs, Mutter, Dunglison, and Metcalf. He graduated with distinction in medicine in March, 1851. The subject of his

graduation thesis was "Enteromesenteric Fever." There were 228 men in the graduating class.

Dr. Haggard located in Gallatin, Tennessee, in May, 1851, and soon established a large practice. In 1859 he married Martha, the oldest daughter of Dr. and Mrs. Elmore Douglass, who bore him two daughters and died in 1866. Her mother had been previously married to Governor Sam Houston.

At the outbreak of the Civil War, the border state of Kentucky was torn with discord. Families were divided in their allegiance. Brothers took opposite sides in the great conflict. Dr. Haggard stood for the preservation of the Union and remained at his post of duty as one of the two physicians for the entire population of Sumner County, Tennessee. His brother Volney entered the Confederate service and was killed at Manassas.

Dr. Haggard moved to Nashville, Tennessee, in 1875. In the first year of his residence in that city he became an instructor in obstetrics in the Medical Department of the University of Nashville and Vanderbilt University.

In 1884 Dr. Haggard was chosen to fill the chair of diseases of women and children in the medical department of the University of Tennessee, which he occupied with great enthusiasm and success until 1900. At the meeting of the American Medical Association at New Orleans in 1885 he was elected chairman of the section on obstetrics and diseases of children. He was for many years one of the attending surgeons at the Nashville General Hospital and was also made gynecologist to St. Margaret's Hospital. He was the first president of the Southern Surgical and Gynecological Association in 1888; in 1892 he was elected president of the Nashville Academy of Medicine; and in 1893 he was one of the honorary presidents of the Pan-American Medical Congress. He was a teacher of gynecology and abdominal surgery for nearly a quarter of a century, and thousands of his former students throughout the South and West bless and honor his memory.

In 1870 he married Jane Douglass, a daughter of Mr. and Mrs. Robert Bruce Douglass. They had two children, William David, Jr., born in 1872, and Douglass, born in 1876, both of whom are physicians. The elder son was associate to the chair of abdominal surgery and gynecology in the University of Tennessee before its amalgamation with Vanderbilt University in 1911, when he was made professor of clinical surgery.

Among the first of the old school surgeons to embrace the Listerian principle, Dr. Haggard practiced it scrupulously and at the same time imbued his associates and students with its tenets. It seems incredible that it required champions such as he. In debate he was forceful and convincing. As an operator his boldness was tempered with discretion, his gentleness was harnessed with rapidity, and his large experience mellowed overzealousness into that most coveted of all surgical attributes, good judgment.

Dr. Haggard was prompt and scrupulous in all things. He did his day's work faithfully with no regard for the morrow. His day began early and punctuality was his creed. He once told me this practice had saved him much time and enabled him to accomplish his self-imposed tasks. He applied the Golden Rule in all the relations of life. I asked him how this rule could be applied to an enemy and he said: "If one places himself in his enemy's place and gives his enemy credit for honesty, he can at least be reconciled to the position his enemy takes." He treated his friends with the greatest consideration. He accepted the sorrows and the difficult trials of life with courage and fortitude. The mellow radiance of his loving personality permeated every private, social, and professional effort of his successful and useful life.

Many surgeons throughout the South received their early training under this illustrious teacher who inspired them with real manhood, the joys of personal service, and the splendor of surgical achievement. In one class he trained, three surgeons who added luster to the South and its long line of eminent men: Dr. Richard Douglas, of Tennessee; Dr. W. E. B. Davis, of Alabama; and Dr. John Wesley Long, of North Carolina. Dr. Long made the speech in presenting the teacher with the customary gold headed cane of that period. Each of these men succeeded their teacher and mentor as president of the Southern Surgical Association and received many other honors in this country and abroad. They were among the first group of early and enthusiastic men in the South in the development of abdominal surgery in the eighties. Dr. Haggard fired his classes with admiration of the heroic and humane phases of a doctor's grave responsibilities and unusual opportunities for superb, if sacrificing, service. The ethics, traditions, and ideals of the forefathers in medicine were very real and very sacred to him. His wealth of knowledge of the historic episodes of medicine were as a tocsin to the ambitions of his hearers. He made a moving pageant of the unheralded ride of Ephriam McDowell along the self-same road that bounded the college campus on his way to the Hermitage, twelve miles away, where, in 1822, he performed his ninth ovariotomy, a score of years before the profession knew that such a thing was possible. He had ridden horseback from his home in Danville, Kentucky, and no less a personage than General Andrew Jackson assisted him at the operation. This intrepid spirit, brave and tender in peace as he was fearless and unconquerable in war, "held the hand of his neighbor and otherwise supported her fortitude." The patient was a Mrs. Overton, who thanked God and honored Dr. McDowell for her recovery. When the surgeon presented the check which her husband had given him at the little bank on the public square, the cashier counted out $1500.00. He returned the money, saying he had told Mr. Overton that his bill was only $500.00. A runner was dispatched to the Hermitage, who returned with the message from the husband saying that he had understood the amount of the doctor's charge, but

had tendered him this additional honorarium with his thanks and with the earnest request that he accept it.

It was through Dr. Haggard's co-operation with Dr. W. E. B. Davis that the Southern Surgical and Gynecological Association was organized. Dr. W. E. B. Davis and the writer, in 1887, organized the Alabama Surgical and Gynecological Association. Dr. Haggard had the vision of an association embracing the entire South which had no outlet for its work and no special societies. At the first annual meeting of the Alabama Surgical and Gynecological Association, it was converted into the Southern Surgical and Gynecological Association, Dr. Haggard was the first president in 1888 and was succeeded by Dr. Hunter McGuire of Richmond. Dr. W. E. B. Davis was the first secretary. The name was later changed to the Southern Surgical Association. Perhaps more than any of his confrères in the launching of this society destined to play such an important rôle in the development of advanced surgery in the South, Dr. Haggard had a vision of its rare usefulness. He prophesied a unique position for this brain-child of his imagination. It has united the flower of southern surgeons with the nationally known colleagues from the great centers. The meetings of this distinguished group have created a literature in its two score volumes of *Transactions* with which few other surgical societies are comparable.

As a writer on gynecology and the earlier abdominal surgery, he showed a prophetic grasp of the developing new era. His contributions were prepared with meticulous care and betokened unusual accuracy of observation and deduction. He was by nature gifted with those qualities as a speaker which win men over, and his happy sense of humor made him a genial companion. A keen and critical wit was redeemed by a kindly nature that freed satire from the sting that is too often its spark and its dart. He was an interminable, tireless worker, and his day book for many years recorded in a careful hand visits to the number of fifty or more a day over long periods. In his very plan of giving himself, he became known as the well beloved. Good-will flowed into his life. He planned carefully, acted logically, and refused to be moved by precedent alone. He was possessed of great magnetism and a gracious personality. He was essentially an optimist. Always captain of his surroundings, he was steadfast and immovable in a just judgment.

The enthusiasms of accomplishment and the appeal of friendship were essentially linked with his emotions. Every hour was jeweled with purposeful effort. He wore the red badge of courage. Well poised, sane, generous to a fault; he was the soul of honor. His life was a religion of service. His surgical resourcefulness was inspired by a wealth of experience and his wellnigh unerring judgment was allied with supreme caution.

J. D. S. DAVIS.

DE NATVRÆ DIVINIS CHARACTERISMIS;

SEV

Rarũ & admirandũ ſpectaculũ, cauſis, indiciis, proprietatibus rerum in partibus ſingulis vniverſi, Libri II.

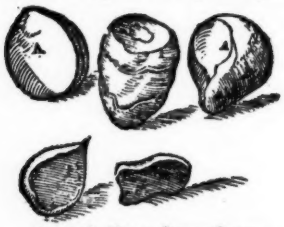
AVCTORE

D. CORN. GEMMA, Louanienſi, Regio Medicinæ profeſſore.

Peculiarem partis vtriuſque materiem vel argumentum ſequens pagina planiùs explicabit.

ANTVERPIÆ,
Ex officina Chriſtophori Plantini.
Architypographi Regij.
M. D. LXXV.

Calculi veſicæ quales à nobis ſpectati ſæpius.



Cortices lapidum veſicæ ac velut exteriora putamina.

Varij renum lapides.

natum, ſæpiſſimè verò in Lapidis ſpecie, aut corporis alterius indura-

turi. Cõſule quæ ab Galeno veterũ plures de mirandis generibus abſceſſuum tradiderunt, vbi nunc acus, nunc cultri, atque nouacula, nunc inſecta quædam animantia ſunt reperta. Naturam habent qui paſſim naſcuntur Lapides; cuiuſmodi nunc ſub lingua gemites, nunc in pulmonibus, atque per os excretos vidimus, paruos, albicantes, duros ſupra modum: nunc in folliculo fellis per inflammationes proximorũ viſcerum, aut obſtructiones diuturnas coaluiſſe deprehendimus: erant hi ſeſe angulosi, extrinsecus nigri, intus ſubflaui, ſuſti, ac ſæpe coloris varij. Exemi ab vno hydroprico ſcito ſolum fellis calculos 32. quorum minimus piſi communis magnitudinis reſpondebat, maximus nuci auellanæ. Eſt & in

Abſceſſus memorabiles. Videre eſt multa memorabilia apud Lycoſthenem anno 1550.

Lapides in humano corpore reperti & varia eorundẽ hiſtoria.

Ratus caſus.

Lapides è pulmone excreti. Lapides in fellis folliculo nati. Lapis in humano cerebro repertus.

Saccum exhalamentum circa membranas figmoides arteriæ aortæ.

Oſſiculum repertum in corde humano.

Os cordis cerui,

1 Lapis in pyloro genitus. 2 Lapis in cæco intestino natus. 3 Vermis latus.

4 Lumbrici teretes. 5 Acarides. 6 Vermes polymorphi.

mirabile quiddam & infrequens: certè putredinis forma plurimum debet; ſæpiſſimè tamen ac multo apertius vindictam numinis repræſentat, vt & furores, & ſanguinis vomitum in plerisq; lacertas 3. aut 4. à medicamento purgante dejectos ſemel atque iterum vidi: ſemel & olinaria quædam corpora plura 60. numero ex aluo pueri prodeuntia per dyſenteriam. Semel conſimili morbo velut vitellos ouorum indurato: ſemel vt ſaturas piſonum. Non parum me attonitum reddidit ingens copia rerum memorabilium excreta per ſedem, in muliere florentis ætatis, quæ per nouem annos variè inſandis inteſtinorum doloribus conflictata, membrana

Excretiones per ventrem admirabiles.

Rara hiſtoria grauida in viciſſitudines mutata.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

ALFRED BROWN, M.D., F.A.C.S., OMAHA, NEBRASKA

THE NATURE OF DIVINE CHARACTERISTICS BY CORNELIUS GEMMA

THE learning and knowledge of any given subject when studied as a historical problem is gauged from a cross section obtained by a review of the works of the prominent men of the period under consideration. This being taken as a criterion, an evaluation of the medical and surgical knowledge of the sixteenth century is particularly difficult to determine accurately, as in making such an evaluation both sides of the scale must be considered. On the one hand are the practical workers of the period, usually sane, solid individuals, in great part beginning *de novo*, taking things as they find them and doing the best they can with them. From this group, in surgery at least, have come the greater part of things worth while, not only in the sixteenth century but throughout the entire existence of the science. To this group belong such men as De Vigo, Brunschwig, Paré, Franco, and many others. During their lives, they were greatly in the minority and a larger, more influential group dominated the surgical world. To this belonged the teachers in the schools. These men, steeped in the tradition of ancient medicine and inheriting some, if not all, of the mysticism and belief in the supernatural of demonology and its attendant nonsense, held high positions, and their word spread through the rank and file of the medical profession and was considered by many the law and the gospel. Naturally they represented a sliding scale, not quite from the sublime but some of them surely to the ridiculous.

To us the books of the men of the first group stand out as the important works of the period, but in order to get an insight of what was going on in surgery we should turn to the other end of the scale and see what we find there. The work of Cornelius Gemma appears to be about that end of the scale for it shows us a work written by a man, well thought of, evidently well read, and in some ways a good practitioner, who, not satisfied with his attainments in medicine and surgery, branched out into almost all other fields and took upon himself the task of explaining almost everything under the sun. While doing this he invokes the aid of all the stories and old wives' tales of wonderful happenings in the realm of human pathology. In the obstetrical portion of the book he shows all the monsters previously shown by Jacob Rueff and apparently believes in them. In the portion devoted to foreign material in the body he cites the case of a fourteen-year-old girl who, after a considerable sickness, passed a living eel by rectum. He shows a picture of the eel but does not vouch for the truth of the story although he apparently believes in a case in which a woman discharged pieces of wood and fully formed leaves of a tree from an abscess at varying periods over a space of nine years.

He includes among foreign bodies, calcification of the valves of the heart, illustrates them in the case of the semilunar valve, and describes the pathology as "stony sedimentation." He describes stones in the lung, gall bladder, brain, urinary bladder, and kidney. When he comes to the digestive tract he describes stone in the pylorus, and cæcum; worms of various types: the broad worm, round worm, and apparently pin worms, but goes on to the polymorphous types such as frogs and salamanders. These he speaks of as certainly miraculous and infrequent.

He associates the stone which he places in the cæcum with clinical symptoms when he says: "More wonderful (a case) where a somewhat aged but large woman passed a stone, almost round, but a little oval, the outside of which was partly brown and partly black, as if it had been burnt: which when an attempt was made to perforate it, fell into two parts and showed within a substance like glass or transparent crystal with many striæ and radii leading to a common center. I did not doubt that this stone was carried in the cæcum for many months because of the pain which she had felt in that place and the dragging tension and weight in the right ilium under the false ribs where the cæcal intestine is bound with fibrous membrane both to the peritoneum and liver and the mesentery."

Cornelius Gemma was born in 1535, the son of a physician. He rose in his profession until he became regius professor of medicine at Louvain. He was an authority on "The Pest" and obtained a great reputation in the epidemic of 1574, and later in 1579 himself fell a victim of the disease and died in that year. His principal book, commonly known as *Cosmocritica*, was printed in 1575 at the Plantin Press, in Antwerp. It is a hodgepodge of distinct erudition with an admixture of nonsense which, though the author did not wholly believe it, nevertheless was hardly worth printing except that it is fascinating in its showing of the superstition existing in the mind of at least one of the principal medical men of the period.

REVIEWS OF NEW BOOKS

THE seventh edition of Phillips' *Diseases of the Ear, Nose and Throat*[1] has new chapters dealing with infantile mastoiditis and paranasal sinus infection wherein gastro-intestinal symptoms predominate. There is also a revised chapter on the hearing tests.

The chapters on bronchoscopy and æsophagoscopy are much improved over the other editions. There is full illustration of all new instruments, and the technique as used in the Jackson Clinic is well portrayed. The fact that this book has gone through seven editions recommends it both as a text and reference. J. GORDON WILSON.

"RECONSTRUCTIVE Surgery," "Nelson,"[2] is the title which appears on the cover of an out-of-the-ordinary worth while book on major corrections of the face.

The author has had the advantage of excellent basic training and the somewhat rare combination of an imagination and habit of attention to essential detail. He has also had large opportunity to observe and to develop himself along these lines both in his war work and in the large general clinic with which he is associated. All of these influences are reflected in this work. Without attempting categorically to give credit for all inherited knowledge or methods, he is more than ordinarily generous in his acknowledgments and he has salted the whole with his individuality, both by the evident personal touch and by putting the operative demonstrations in the form of readily available stereoscopic cards.

There are 189 illustrations and 88 stereoscopic plates, most of the former and all of the latter being original. In the 166 pages of text he describes related surgical principles and such basic technique as preparation, types of incision, manner of suturing, closing of wounds, dressings, etc., but most of it is devoted to the presentation of the definite plans he himself uses of solving the problems concerned, and it is this latter practice that gives the real usable value to any book on technique.

The making of flaps, transplantation of tissues, cheiloplasty, meloplasty, treatment of salivary fistula, treatment of facial palsy, cosmetic meloplasty, blepharoplasty, preparation of the socket for an artificial eye, restoration of the lids, otoplasty, cosmetic and reconstructive rhinoplasty, correction of abnormalities of the septum, of asymmetry of the nose, of saddle nose, non-specific, of rhinophyma, retraction of nasal bones and lip, of luetic saddle nose, surgery of the columella, and their correlated factors are attacked directly and presented concisely. His training as a rhinologist has made him particularly interested in and adept in reconstructions of the nose and eyelids, and these chapters are preeminent in this well conceived carefully executed work. V. P. B.

IN the preface of a new book on pharmacology and therapeutics,[3] Dr. McGuigan states: "The aim of this book is to present clearly the important facts of pharmacology, and to give the basis for these facts." In this he has succeeded admirably, and students in particular will appreciate the clear and concise way in which he presents the material. Conflicting literature is not reported in detail to leave the student in a maze. While the clinical application of the pharmacological matter is in every case indicated, the therapeutics is of necessity brief. In addition to the discussion of drugs and other therapeutic agents, Dr. McGuigan included also a section on the pharmacopœia and on prescription writing. This is very well done. His emphasis of the metric system is to be commended. Perhaps it would also be commendable if he advocated English instead of Latin. C. A. D.

THE fourth edition of French's well known book, *An Index of Differential Diagnosis of Main Symptoms*,[4] appears eleven years after the third. It is an even larger work than before, consisting of nine hundred and forty-three pages of heavy glazed paper and an analytical index in two hundred and twenty-five pages. Many full colored figures have been added. They are very realistic and most instructive. For instance, the pictures of the cyanosis occurring during influenzal pneumonia are most striking. The value of this work is, of course, unquestioned. It is chiefly a clinical counselor, wisely suggesting the thoughtful consideration of all possible causes of the presenting symptoms. This edition is well up to date with the newer kidney function tests included and a brief summary of the most recent developments in X-ray diagnostic technique. It contains an encyclopedic variety of clinical information. P. S.

JERMAN'S *Modern X-Ray Technic*[5] is an exposition of the details of the technique and procedure in producing the best possible X-ray films. The author bases his material on an unusual

[1] DISEASES OF THE EAR, NOSE AND THROAT; MEDICAL AND SURGICAL. By Wendell Christopher Phillips, M.D. 7th ed. rev. and enlarged. Philadelphia: F. A. Davis Company, 1928.

[2] RECONSTRUCTIVE SURGERY. By Ferris Smith, B.A., M.D. Being a part of Nelson Loose-Leaf Living Surgery. Prepared under the direction of an advisory board comprising the leading surgeons of the profession. Allen O. Whipple, M.D., Editor-in-Chief; Fordyce B. St. John, M.D., Associate Editor. New York, Edinburgh, London, Paris, and Toronto: Thomas Nelson & Sons, 1927.

[3] A TEXT-BOOK OF PHARMACOLOGY AND THERAPEUTICS. By Hugh Alister McGuigan, Ph.D., M.D. Philadelphia and London: W. B. Saunders Company, 1928.

[4] AN INDEX OF DIFFERENTIAL DIAGNOSIS OF MAIN SYMPTOMS. By various writers. Edited by Herbert French, C.B.E. (Military), M.A., M.D. (Oxon.), F.R.C.P. (Lond.). 4th ed. New York: William Wood and Company, 1928.

[5] MODERN X-RAY TECHNIC. By Ed. C. Jerman. Minneapolis: Bruce Publishing Company, 1928.

experience in X-ray technique acquired during the course of many years of actual work with X-ray apparatus. The subject matter is presented in a direct, positive way which cannot be otherwise than helpful to the student and beginner in the X-ray field. When one has had the extended experience in technical X-ray work, not only in the actual practice but also in the instructional side of the work, as has this author, he can speak with authority on the subject that is covered by the book.

This work is written in an entirely impersonal manner. It is characterized by a brief mention or a complete absence of the usual descriptions of the older and antiquated pieces of X-ray apparatus that so many writers feel must be included in works on X-ray. Thus, very little space is wasted on apparatus long since out of use or discarded, such as the static machine, the induction coil, and the gas X-ray tube (which at least 75 per cent of the X-ray technicians of today have never used and many have never seen).

The author stresses the value of standardization of X-ray exposure formulæ and the calibration of X-ray apparatus in order to enable the technician to obtain, with confidence, a constant duplication of results. Thus this method displaces the hit or miss, rule of thumb method which has been in vogue these many years in various X-ray laboratories with the uncertainty of results, frequent failures necessitating reraying, loss of time, etc. Illustrations of the posturing of patients for the more common exposures are given, which provides the technician with a clear visualization of this part of the technique. With this book as a guide, the X-ray technician who is acquainted with the fundamentals of X-ray physics should be able to obtain superior X-ray films for the doctor who depends on his or her services in the technical phases in medical roentgenology.

In a section on "Interpretation," which the author treats in an abstract manner, he stresses the importance of this being the forte of the professional radiologist but does not specifically state that this refers to the medical radiologist (physician), a specialist trained and experienced in X-ray interpretation. In no part of the book is there any reference to the diagnosis of X-ray shadows nor is there any reference to any of the medical problems connected with X-ray work.

Many of the chapters are concluded with an extended question and answer résumé of the subject treated.

This book will be welcomed by the X-ray technician who desires to improve his work and by those who have been students in X-ray technique under the author. EDW. S. BLAINE, M.D.

IN his recently rewritten text of *Urology*,[1] Edward L. Keyes of New York has again made the reading matter both unique and interesting; unique because of the aphorisms and individual experiences of the author; interesting and easily read because the burdensome details of description are omitted. This latter fact is particularly true of embryology and anatomy; it is presupposed that the reader has already gained such knowledge elsewhere; so the book is primarily for one who wishes to gain quickly a view of clinical urology and also the important principles of therapy. From this aspect the subject matter is probably ideal for the beginning course of urology in medical schools.

Clinical urinalysis, or the ability to look at urine and interpret what we see therein, is stressed. Not everybody will agree with the author that the double curve or Béniqué sound should be used for the urethra.

In a thorough discussion of instruments, their use and care, of cystoscopy and pyelography, the use of pyeloscopy (Legueu) is evaluated; although a relatively new procedure, it helps to distinguish fixed deformations of the kidney from temporary defects as no other method does. The gravity method is recommended for all pyelograms.

Blood chemistry of urological patients is important in so far as the non-protein nitrogen and creatinine are retained. The inclusion of a chapter on urologic pharmacopœia is timely.

Infection of the urinary tract has very aptly been given several chapters. Infection of the right kidney in small girls is explained by the excess mobility and susceptibility of this kidney. In chronic renal infections the author believes that the vaccines, whether autogenous or stock, are of no value. He also believes that mercurochrome has no real intravenous antiseptic value.

Throughout the text acriflavine solution, 1:1000, is recommended and favored as a general urinary antiseptic; prophylactically or therapeutically.

The author disposes of ureteral stricture by saying that a stricture or spasm of the ureter must produce symptoms as proven by the fact that dilatations of the ureter relieve the symptoms, or there has been no stricture or spasm. He emphasizes that cystitis is only a symptom and its cause must be sought.

One must note that in chronic infection of the seminal vesicles, vasectomy is preferred to any kind of injection into the vas deferens. In the pages devoted to prostatism and retention, the reviewer could not help but notice that the author stressed the point that the only cystoscopic evidence of bladder paralysis is the open internal sphincter.

For bladder operations, spinal or general anæsthesia is preferred. Prevesical section as a substitute for the "two stage" prostatectomy and as a preliminary to suprapubic lithotomy to obviate the danger of pelvic cellulitis and the shock of cystotomy is strongly recommended.

Tumors of the urinary tract are described in a most sensible manner. Several times the author brings out the point that retractors sometimes obscure bladder tumors, so should be moved into different positions during operation.

[1] UROLOGY. By Edward L. Keyes, M.D., Ph.D., F.A.C.S. New York and London: D. Appleton and Company, 1928.

The subject matter and conclusions are valuable in that father and son have carried on a study of urology from its beginning in America to the present time. HARRY CULVER.

BEGINNING with a chapter on development, Braun, in his book on *Sinus Thrombophlebitis*,[1] discusses the embryology of all the cerebral sinuses. From here on the subject is taken up in chronological order, the various chapters being devoted to anatomy, etiology and pathology, symptoms and diagnosis, and finally treatment.

In reviewing the chapter on anatomy, one is able to gain a clear conception of the relations and abnormalities of the cerebral sinuses and to correlate them with clinical findings. Dr. Braun has done his own illustrating and has left nothing undone in order to clarify the subject.

Every otologist is aware of the protean manifestations of a sinus thrombosis and the difficulty in arriving at a correct diagnosis. Often all signs and symptoms point to involvement of the lateral sinus, but one is too often disappointed in not obtaining the desired results after operative interference. Dr. Braun has kept this in mind and discusses every possible means of arriving at a differential and correct diagnosis. The Tobey-Ayer test based on the Queckenstedt phenomenon is described in determining which jugular is involved. The differential diagnosis of typhoid fever, erysipelas, acute miliary tuberculosis, and septic endocarditis is discussed.

Cognizant of the futility of schematizing the treatment of otogenic sepsis, the author has laid down no hard and fast rules to follow. There are too many variable factors which must be taken into consideration. Each case must be considered individually and the operator guided by his own judgment.

Operative interference on the cavernous sinus is still fraught with danger and great difficulty. The author reports the cure of only two cases following operation, while Dwight and Germain found that 7 per cent recovered spontaneously. The three methods of approach to the cavernous sinus are described and illustrated.

Dr. Braun has given to otology a clinical picture of sepsis of otitic origin and has made it possible to correlate the clinical picture with the underlying pathological condition. He has put into the hands of the specialist a ready reference to be consulted when suitable cases arise. JOHN F. DELPH.

[1] SINUS THROMBOPHLEBITIS. By Alfred Braun, M.D. New York: Paul B. Hoeber, Inc., 1928.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

DISCURSOS UNIVERSITARIOS Y ESCRITOS CULTURALES. By Dr. Juan Pou Orfila. Montevideo: Imprenta Nacional, 1928.

TRANSACTIONS OF THE AMERICAN GYNECOLOGICAL SOCIETY. Vol. 53. For the year 1928. Edited by Floyd E. Keene, M.D. St. Louis: The C. V. Mosby Company, 1929.

EPIDEMIC ENCEPHALITIS IN ASSOCIATION WITH PREGNANCY, LABOUR, AND THE PUERPERIUM. By Frederick Roques, M.A., M.D., M.Chir., (Cantab.), F.R.C.S., (Eng.). Manchester: Sherratt & Hughes, 1928.

OXFORD UNIVERSITY PUBLICATIONS: POCKET ATLAS OF ANATOMY. By Victor Pauchet and S. Dupret. New York: William Wood and Company, 1929.

MALARIA PROBLEMS. By Frederick L. Hoffman, LL.D. Newark: Prudential Press, 1929.

OXFORD MEDICAL PUBLICATIONS: SURFACE ANATOMY. By Arthur Robinson, M.D., F.R.C.S. and E. B. Jamieson, M.D. New York: William Wood and Company, 1928.

SPINAL ANESTHESIA (SUBARACHNOID RADICULAR CONDUCTION BLOCK); PRINCIPLES & TECHNIQUE. By Charles H. Evans, M.D. Introduction by W. Wayne Babcock, M.D., F.A.C.S. Foreword by Charles Gordon Heyd, M.D., F.A.C.S. New York: Paul B. Hoeber, Inc., 1929.

REPORT OF THE INTERNATIONAL CONFERENCE ON CANCER, LONDON—17th-20th July, 1928. Held under the auspices of the British Empire Cancer Campaign. New York: William Wood and Company, 1928.

PROCEEDINGS OF THE TWENTY-SECOND ANNUAL CONVENTION OF THE ASSOCIATION OF LIFE INSURANCE PRESIDENTS. Held in the Hotel Astor, New York, N.Y., December 13 and 14, 1928. (Betterment of Life Insurance Service.)

GETTING READY TO BE A MOTHER; A LITTLE BOOK OF INFORMATION AND ADVICE FOR THE YOUNG WOMAN WHO IS LOOKING FORWARD TO MOTHERHOOD. By Carolyn Conant Van Blarcom, R.N. With an Introduction by J. Clifton Edgar, M.D. 2d ed. rev. New York: Macmillan Co., 1929.

NEUROSURGERY; PRINCIPLES, DIAGNOSIS AND TREATMENT. By William Sharpe, M.D., and Norman Sharpe, M.D. Philadelphia and London: J.B. Lippincott Co., 1928.

THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY IN THE WORLD WAR. Vol. iv. Activities Concerning Mobilization Camps and Ports of Embarkation. By Maj. Albert S. Bowen, M.C. Prepared under the direction of Maj. Gen. M.W. Ireland. Washington: U.S. Government Printing Office, 1928.

A SHORTER ANATOMY WITH PRACTICAL APPLICATIONS. By E. Wolff, M.D., F.R.C.S. New York: William Wood & Company, 1929.

IMPERATIVE TRAUMATIC SURGERY WITH SPECIAL REFERENCE TO AFTER-CARE AND PROGNOSIS. By C.R.G. Forrester, M.D., F.A.C.S. New York: Paul B. Hoeber, Inc., 1929.